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December 1962

FINAL REPORT

RECORDER/REPRODUCER SET, SIGNAL DATA AN/GLH-4 (XW-1)

by
Ted Barger

Ampex Corporation
Redwood City, California

TR-62-2

Contract No. AF 30(602)-2341

Prepared
for
Rome Air Development Center
Air Force Systems Command
United States Air Force

Griffis Air Force Base
New York

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ABSTRACT

The AN/GLH-4 (XW-1) equipment described herein is a modified Ampex Model FR-700-1 recorder/reproducer developed for Rome Air Development Center and intended for use in recording and reproducing data signals in Monitoring Set, Panoramic Data AN/GLR-1. The equipment meets the specifications of Exhibit RADC-5077A and equipment specification SE-48000. All four units have been successfully tested to ST-48000, Preliminary Acceptance Test Procedure, and two units have been tested to RFI specification MIL-I-26600. Special paint, per FED-STD 595, has been furnished at the request of the customer.

The AN/GLH-4 is a fully transistorized wideband magnetic recorder/reproducer designed to MIL-E-4158B. It is compatible with other equipments in the FR-700 - AN/GLH family. A half-hour of dual-track wideband FM recording by the rotary head assembly and dual-track auxiliary data recording by conventional method is furnished at a tape speed of 25 ips. An hour of wideband single-track and dual-track auxiliary recording is provided at 12.5 ips. The wideband signal circuitry has been optimized for pulse response by modification of the record/reproduce electronics.

Signal connectors on the dubbing panel have been duplicated by connectors on a top-mounted junction box, which also provides a connector for operation from a remote station. Record, Reproduce, Fast Forward, and Rewind controls are provided at the customer's remote panel along with control status indication, end-of-tape indication, record confidence (monitor) indication, and end-of-tape anticipation indication 45 seconds before end-of-tape.

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The work performed under EP 759, "FR-700 Modification (RADC)" and Exhibit RADC-5077A is summarized in the following sections of this report. This project involved modification of the FR-700-1 wideband magnetic tape recorder/reproducer per the above exhibit and its ammendments of 27 October 1960 and 13 March 1961. The modified FR-700 equipment, designated Recorder/Reproducer Set, Signal Data AN/GLH-4 (XW-1), is intended for use in recording and reproducing data signals in Monitoring Set, Panoramic Data AN/GLR-1.

A description of the basic FR-700 recorder, an outline of the FR-700 modifications specified by Exhibit RADC-5077A, and a brief description of the completed AN/GLH-4 equipment are given in this section of the report. Section 2.0 provides a more detailed description of the modifications and summarizes the results of the Preliminary Acceptance Tests. Section 3.0 evaluates the modifications with respect to the performance specification, SE-48000. A copy of SE-48000 is provided in Appendix I. ST-48000, Test Procedure Specification, Preliminary Acceptance Test, is provided in Appendix II. This specification includes the Model FR-700 System Test Procedures (Appendix A), the Preliminary RFI Test Procedures (Appendix B), and the Data Sheets for the preliminary acceptance tests of Equipments 101 through 104 (Appendix C). Copies of RFI test reports on Equipments 101 and 104 are provided in Appendix III.

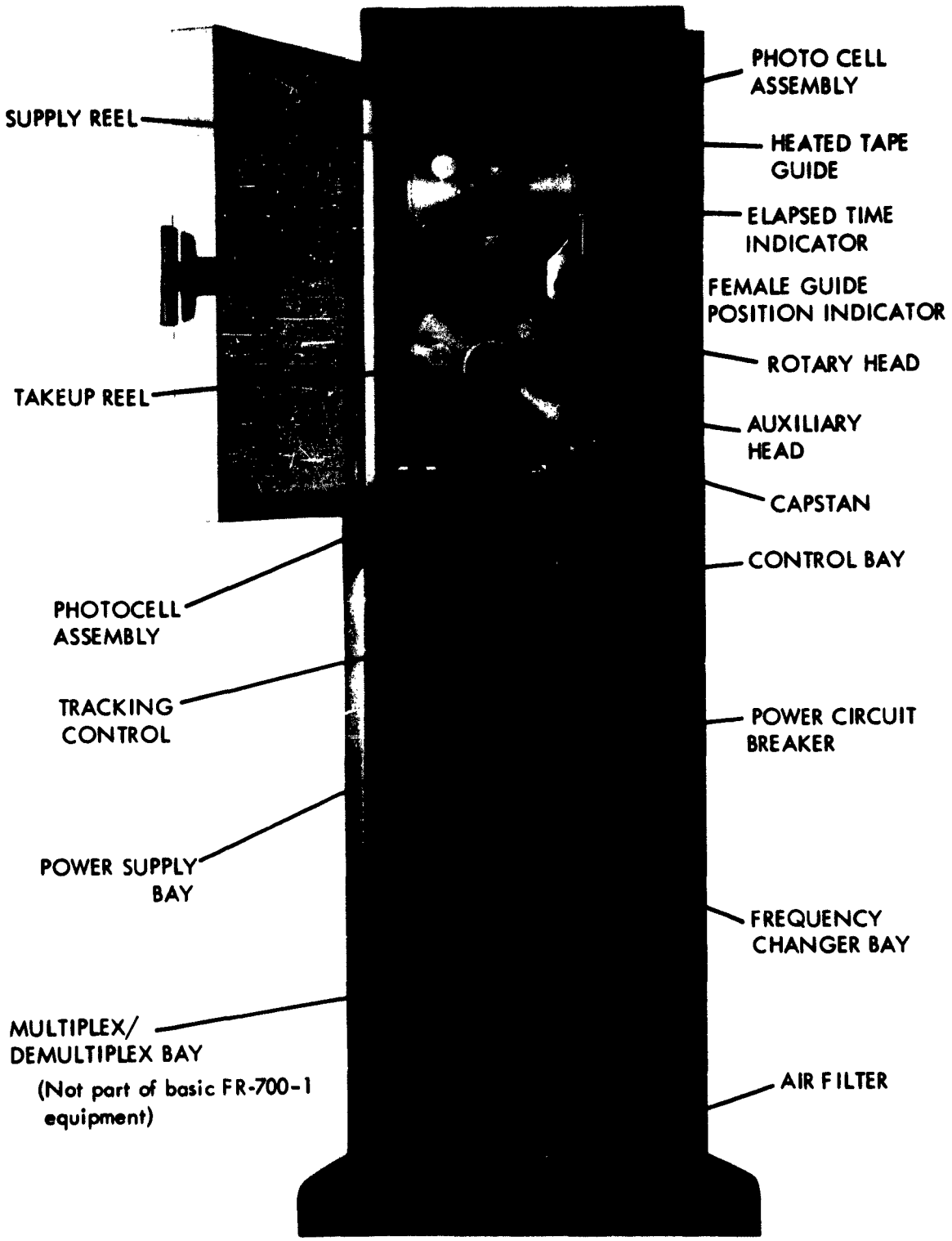


Figure 1a. FR-700 Recorder/Reproducer, Arrangement of Sub-assemblies

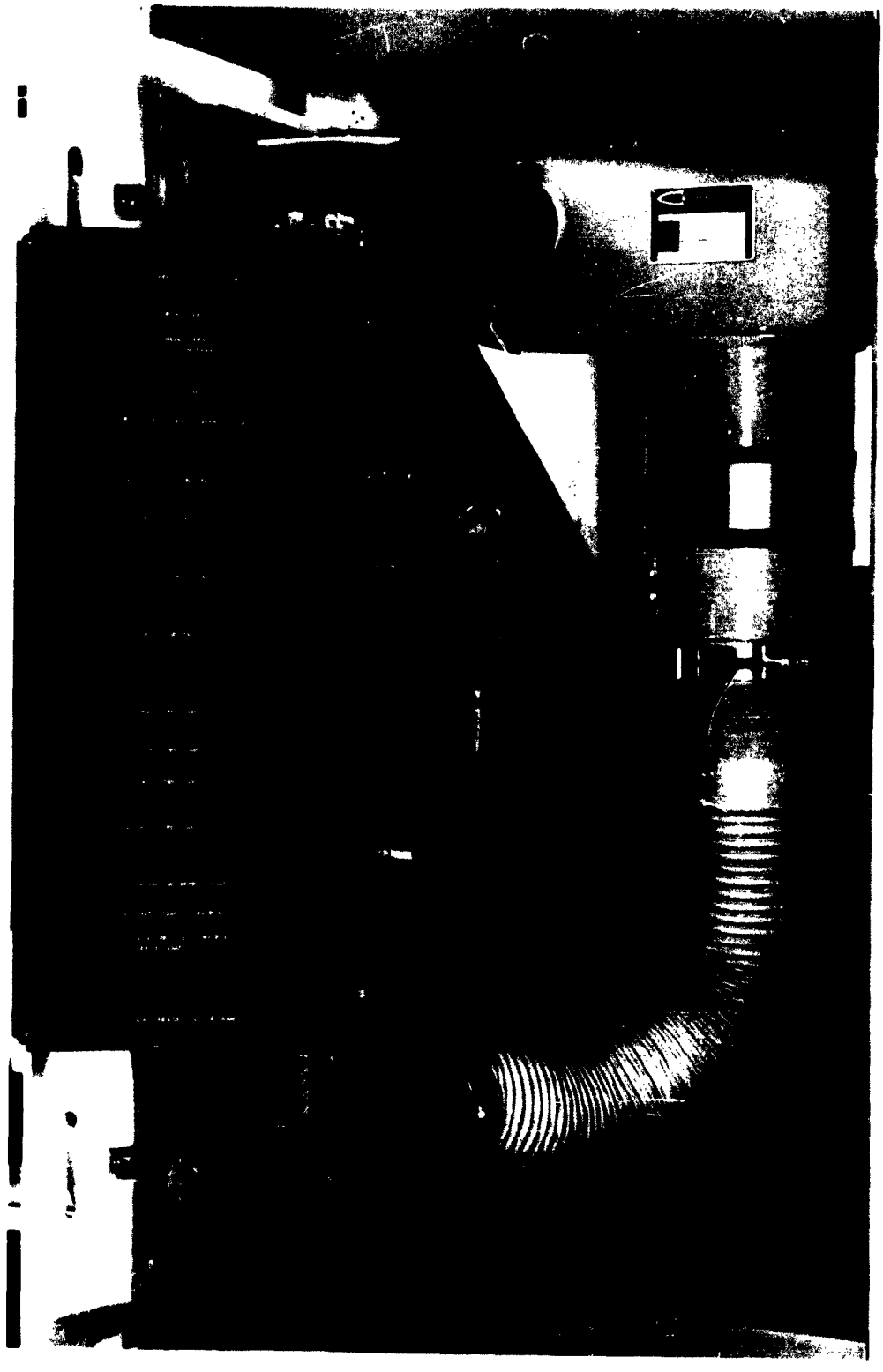


Figure 1b. Tape Transport In Open Position

1.2 DESCRIPTION OF FR-700 (See Fig. 1a)

The FR-700 is a fully transistorized, compact wideband magnetic tape recorder/reproducer that meets the design intent of MIL-E-4158B. Basically, it consists of (1) a tape transport assembly, including tape handling components, wideband rotary and auxiliary head assemblies, rotary head drum and capstan servos, control and monitor bay, and card rack; (2) a switcher/servo bay containing reproduce and servo electronic printed circuit cards; (3) a power supply bay; and (4) the frequency changer bay. All assemblies are mounted in a 75-inch cabinet which is accessible from all sides. The equipment is shielded to reduce RFI to a minimum. A temperature control system circulates cooling air to all units from a filtered air in-take in the bottom of the cabinet; no outside cooling source is required.

The FR-700 is compatible with the AR-300 and AN/ALH-4 series of recorders. Specifications may be found in the FR-700 manual.

1.2.1 Method of Recording

One or two wideband tracks are FM-recorded in the passband from 10 cps to 4 mc ± 3 db, and two auxiliary data tracks are direct recorded in the passband from 300 cps to 15 kc ± 3 db. A 200-cps control track and a monitor track are also recorded as part of a confidence indication system for proper transport operation.

The upper tape speed, 25 inches per second (ips), provides for dual-track recording on both the two wideband and the two auxiliary data channels. This speed may be halved to 12.5 ips for single-channel wideband recording and dual-channel auxiliary recording. Record time per reel of tape is one-half hour for dual-track recording and one hour for single-track recording.

Frequency modulation is employed to record the wide frequency spectrum of 10 cps to 4 mc because FM shifts the spectrum upward, reduces the number of octaves to be recorded, and permits the whole spectrum to be recorded on a single track. In addition, the signal-limiting action of the FM system provides automatic amplitude matching of the multiple head outputs, which vary in sensitivity in both Record and Reproduce modes. Conversion of the recorder input signal to an FM signal takes place in a modulator, where the input signal modulates two oscillators operating at frequencies that result in a 6-mc FM output when they are heterodyned. The FM output of the modulator is applied by the head drivers to the magnetic heads at saturation level.

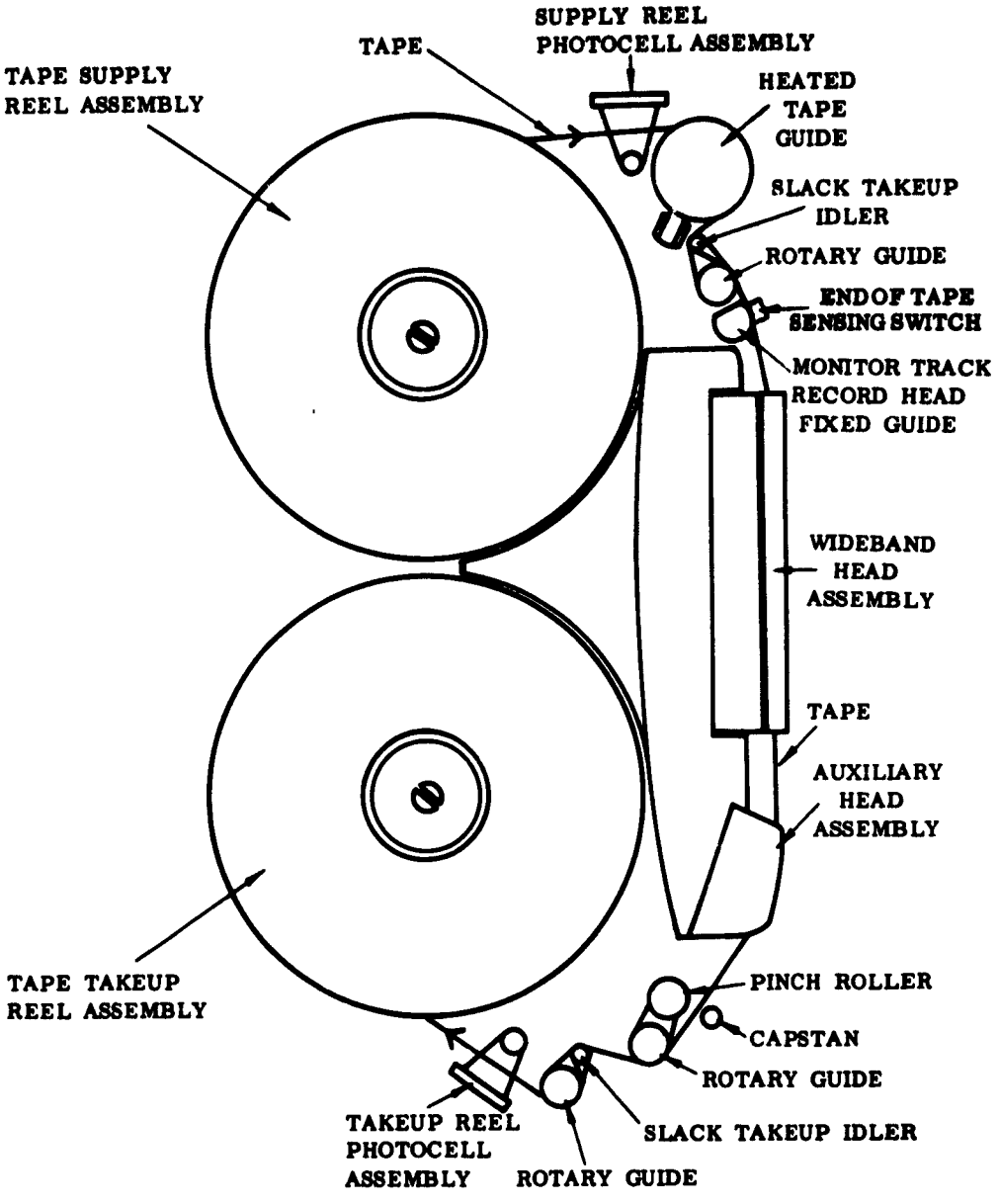


Figure 2 Arrangement of Tape Handling Components

1.2.2 Tape Transport Assembly (See Fig. 1a, 1b)

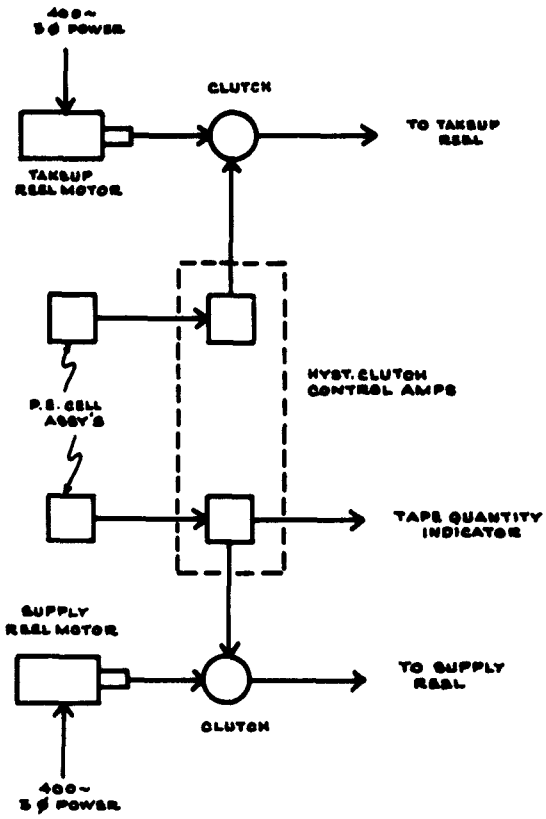
The connecting cables for the tape transport permit the transport to be swung out for access to the components mounted on the rear and to the switcher/servo box (see Fig. 1b). In the closed position, the transport is held in place by two locking catches. A clear glass door provides rf shielding and allows observation of tape handling.

The tape transport provides handling facilities for transporting two-inch magnetic tape over the heads at closely controlled, preselected speeds of 25 and 12.5 ips.

Mounted on the top surface of the aluminum base casting of the transport are the tape handling components and the magnetic recording head assemblies. The card rack is mounted on the rear surface of the base casting and accommodates 18 plug-in printed circuit cards. An additional 16 cards are plugged into the switcher/servo box behind the transport. Also mounted on the rear surface of the transport are the control circuit harness and relays, and other electronic parts too heavy for mounting on the cards. Tape transport connections are made through captive cables which terminate in connectors, enabling easy disconnection of the transport from the rest of the equipment.

1.2.2.1 Tape Handling . . . The tape handling components include the tape supply reel assembly, the tape guide assemblies, the capstan assembly, and the take-up reel assembly (see Fig. 2). Since it is important that the tape be driven over the heads at an accurately controlled speed, a constant speed motor is used to drive the capstan during Record. When the tape is reproduced, the speed at which it was recorded is accurately duplicated by servo control of the capstan speed to insure constant tracking over the recorded tracks.

To prevent mishandling of the tape during any mode of operation, the supply and take-up assemblies are each driven by a separate electric motor through a hysteresis clutch. This is controlled by a system consisting of a tape supply and take-up photocell assembly (see Fig. 3) and a printed circuit card plugged into the tape transport card rack. The current flow through the supply or take-up clutch coils is normally proportional to the radius of tape remaining on the supply or take-up reel; however, a fixed maximum current is driven through the supply clutch coil in the Rewind mode and through the take-up reel coil in the Fast Forward mode. Tape tension between reels is maintained by arrangement of the drive motors in such a way that they tend to drive the reels in opposite directions, each reel being driven to take up tape. When all slack tape has been taken up and the slack take-up idlers are under tension, the tape is held at rest, ready to be drawn across the heads by the action of the capstan assembly. The torque applied to each reel is in propor-



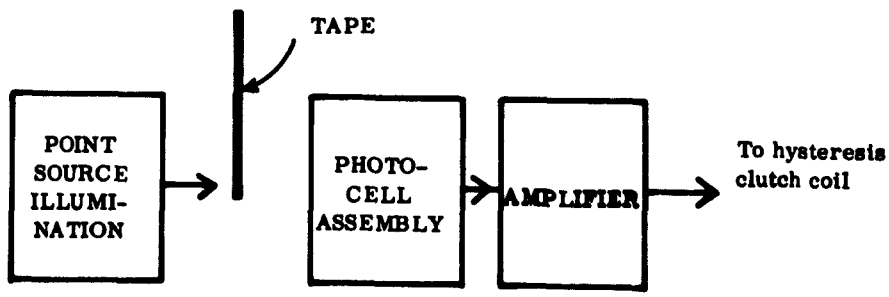


Figure 3. Block Diagrams, Hysteresis Clutch Control and Photocell Circuit Arrangement

tion to the radius of tape on the reel because current through the hysteresis clutch coil is controlled by the amplified output of the tape-sensing photocell assembly, which in turn is controlled by the amount of tape on the reel (see Fig. 3). Additional control of tape tension against transient disturbances is provided by two slack take-up idlers, which also serve as tape guides. One idler is fitted at the exit from the supply reel assembly, the other at the entrance to the take-up reel assembly (see Fig. 2).

1.2.2.2 Head Assemblies . . . The two wideband channels are recorded by a rotary head assembly (see Fig. 4a) which records information transversely on the tape at right angles to the direction of tape travel. To insure continuity of the recorded data on the tape, the rotary head drum has four heads spaced 90 degrees apart (see Fig. 5). At all times at least one of these heads is in contact with the tape and can record or reproduce. In addition to the input data, two time base marker pulses are recorded for each revolution of the head drum (see Fig. 5). They insure correct reproduction of the recorded data time base when the tape is played back (see Para. 1.2.3.2).

A control track is NRZ-recorded longitudinally on the tape for use during reproduction (see Fig. 5). The control track head is mounted on the wideband head assembly tape guide to contact the tape close to the rotary head drum.

A monitor track is recorded longitudinally at the edge of the tape by a d-c energized head located in a fixed tape guide (see Figs. 2 and 4b). The monitor track is recorded before the tape passes over the wideband heads and is erased every time it is crossed by a wideband record head moving transversely across the tape.

The monitor track reproduce head, an erase head, and the two auxiliary data record heads are mounted in one auxiliary head assembly (see Fig. 4c). When the tape passes over the auxiliary head stack, the partially erased monitor d-c track produces a pulse output from the monitor track reproduce head. This output drives the amplifier for the monitor circuit and causes the monitor lamp on the control panel to light, indicating that recording is in progress (see Fig. 6). The monitor amplifier is mounted on a printed circuit card that plugs into the transport card rack.

An erase head in the auxiliary head stack is provided to insure a noise-free tape surface on which to record the two auxiliary data channels. The head is so placed that the tape passes over it before it reaches the auxiliary record heads. Auxiliary data recording is by conventional longitudinal recording methods.

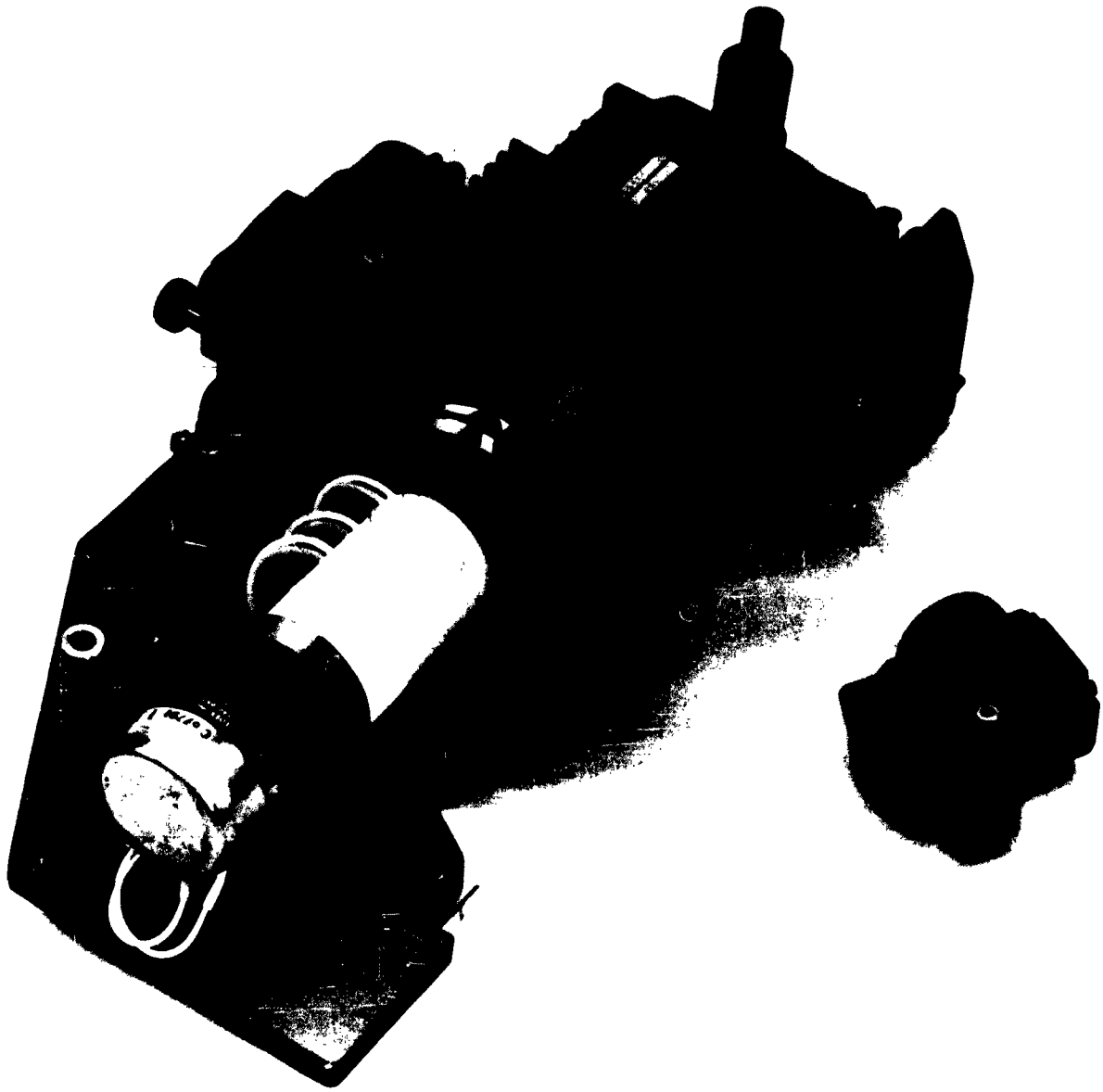


Figure 4a. Wideband Rotary Head Assembly

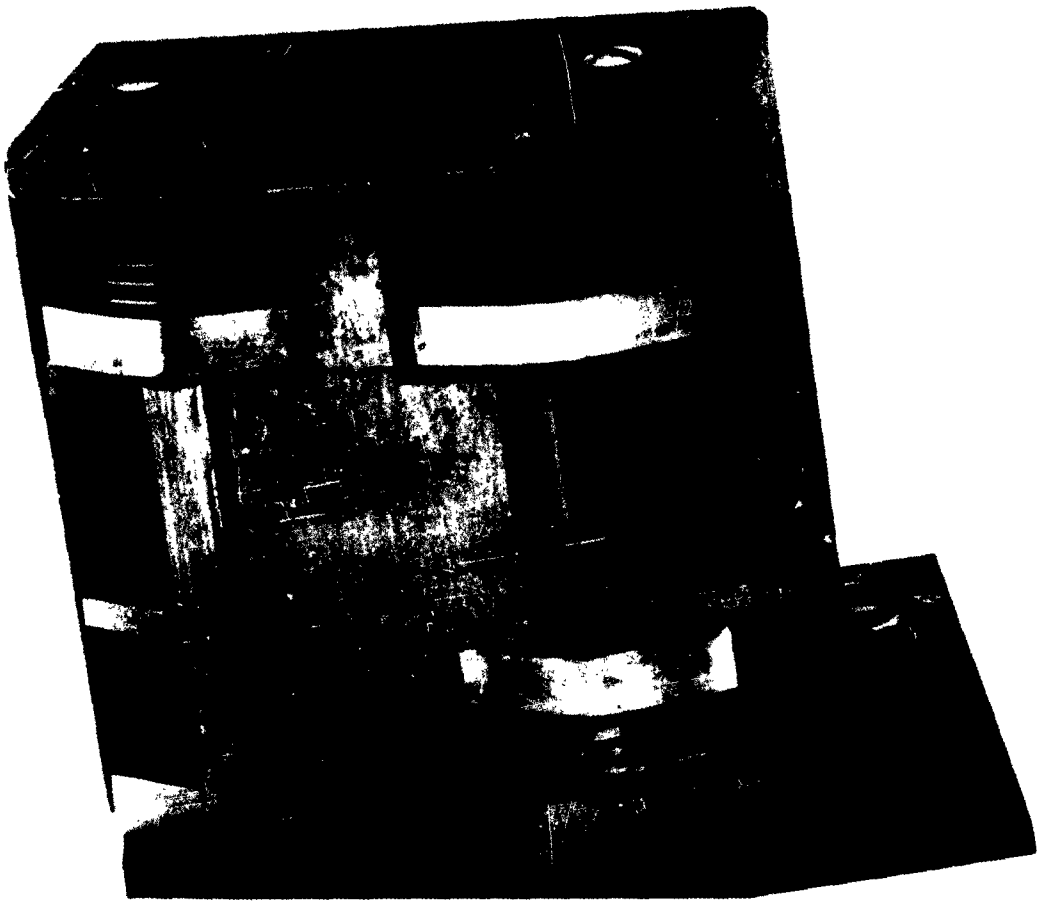


Figure 4b. Auxiliary Head Assembly

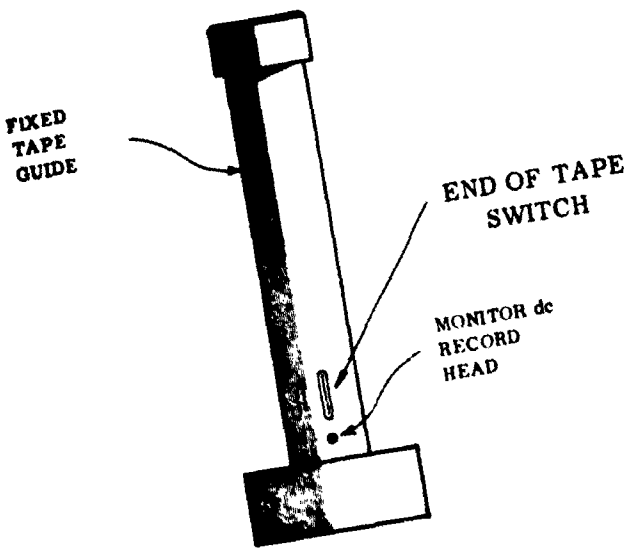


Figure 4c. Monitor Record Head

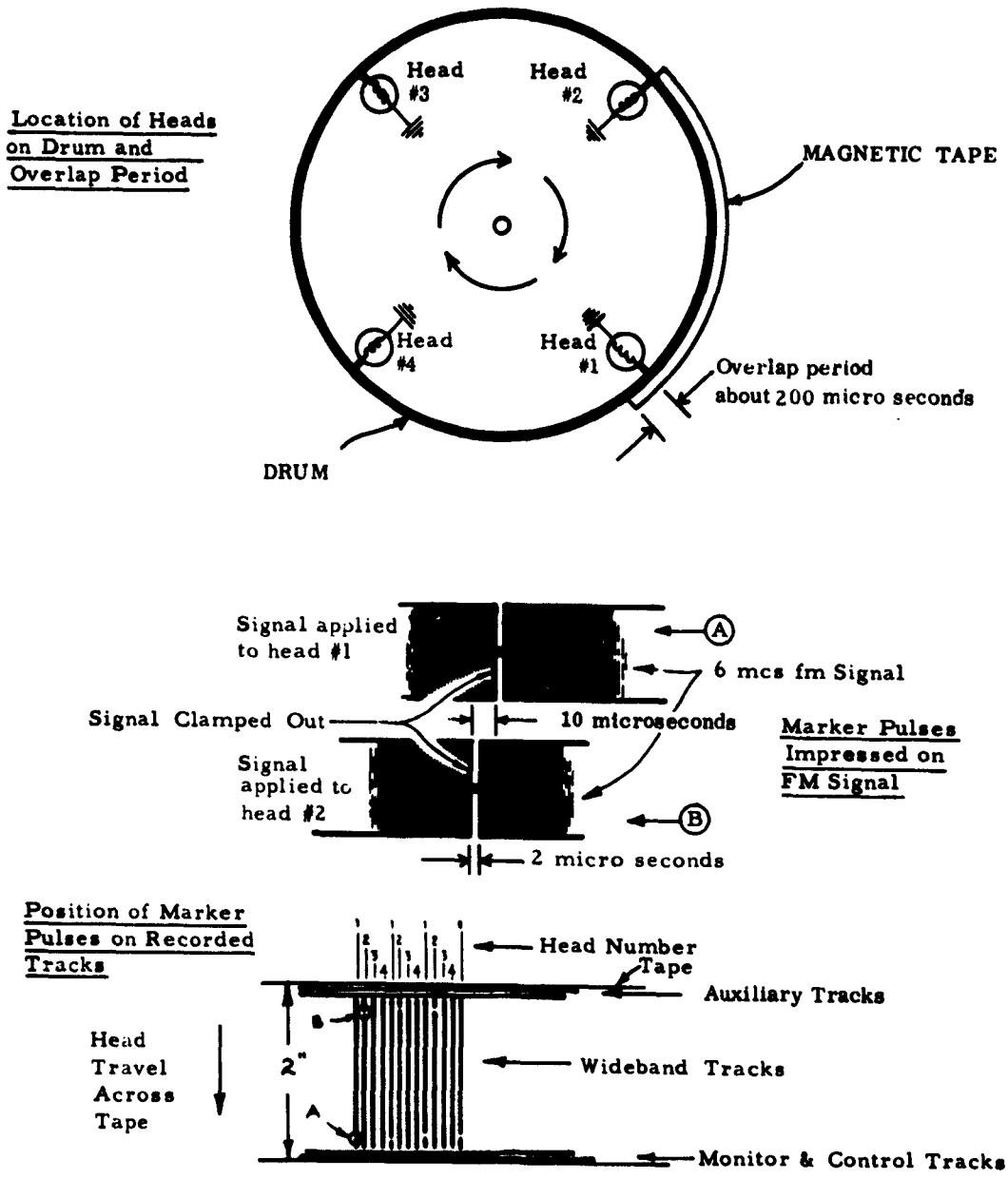


Figure 5. Location of Headson Drum and Application of Marker Pulses to Signal Recorded on Tape

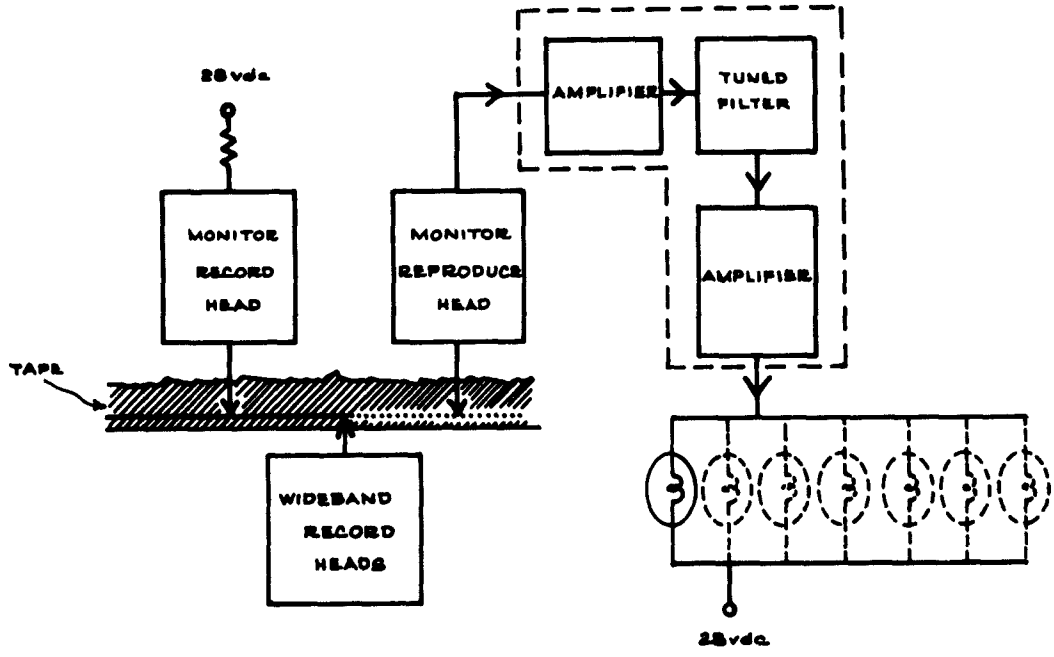


Figure 6. Block Diagram. Monitor Track Circuit

1.2.2.3 Control Bay . . . The control circuitry consists of backlighted pushbutton switches, a potentiometer, indicator lamps, relays, solenoids, and thermostats, all interconnected by a wiring harness. All operational pushbutton switches are mounted on the front panel of the control bay (see Fig. 1a). They are: Power On, Power Off, Record, Reproduce, Fast Forward, Rewind, and Stop. The mode of operation can be changed only by switching first to the Stop mode. A backlighted monitor lamp illuminates when recording is actually taking place. A tape speed selector switch in the control bay drawer permits selection of either 12.5 ips for single-track or 25 ips for dual-track wideband recording. A tracking potentiometer (see Fig. 1a) provides longitudinal positioning of the tape in the reproduce mode for optimum tracking of the heads over the recorded tape.

Control of the equipment is by hermetically sealed relays, mounted in the relay bracket assembly on the rear of the transport. Most relays operate from the 28-vdc unregulated supply, but some are operated from the 24-vdc regulated supplies to provide power failure safety interlock.

Solenoids are used throughout the equipment to provide remote control of components. The rectifiers associated with them reduce switching transients caused by the collapse of a magnetic field when the current flow through a solenoid is interrupted.

To protect the equipment from damage by overheating, thermostat disconnect switches are located at various points inside the transport. When cooled, these thermostats are self-resetting. The control circuit for the temperature control system is mounted on a circuit card in the transport card rack.

An end-of-tape sensing switch is fitted to a bracket close to the solid tape guide that mounts the monitor dc record head (see Fig. 2). When the transport is correctly threaded, the mylar base of the tape serves as an insulator between the switch spring contact and the fixed tape guide. When the tape supply runs out, the spring grounds a contact on the fixed guide, which energizes the stop relay to return the equipment to Stop mode.

1.2.2 Wideband Record Electronics (see block diagram, Fig. 7)

1.2.3.1 Modulator . . . The frequency modulation record system consists of a modulator and a gated head-drive amplifier mounted on printed circuit cards which plug into the transport card rack. The input signal to the modulator, between 10 cps and 4 mc, modulates two oscillators whose outputs are mixed to produce a 6-mc frequency modulated carrier. The carrier consists of a carrier frequency plus sidebands, distributed symmetrically about the carrier.

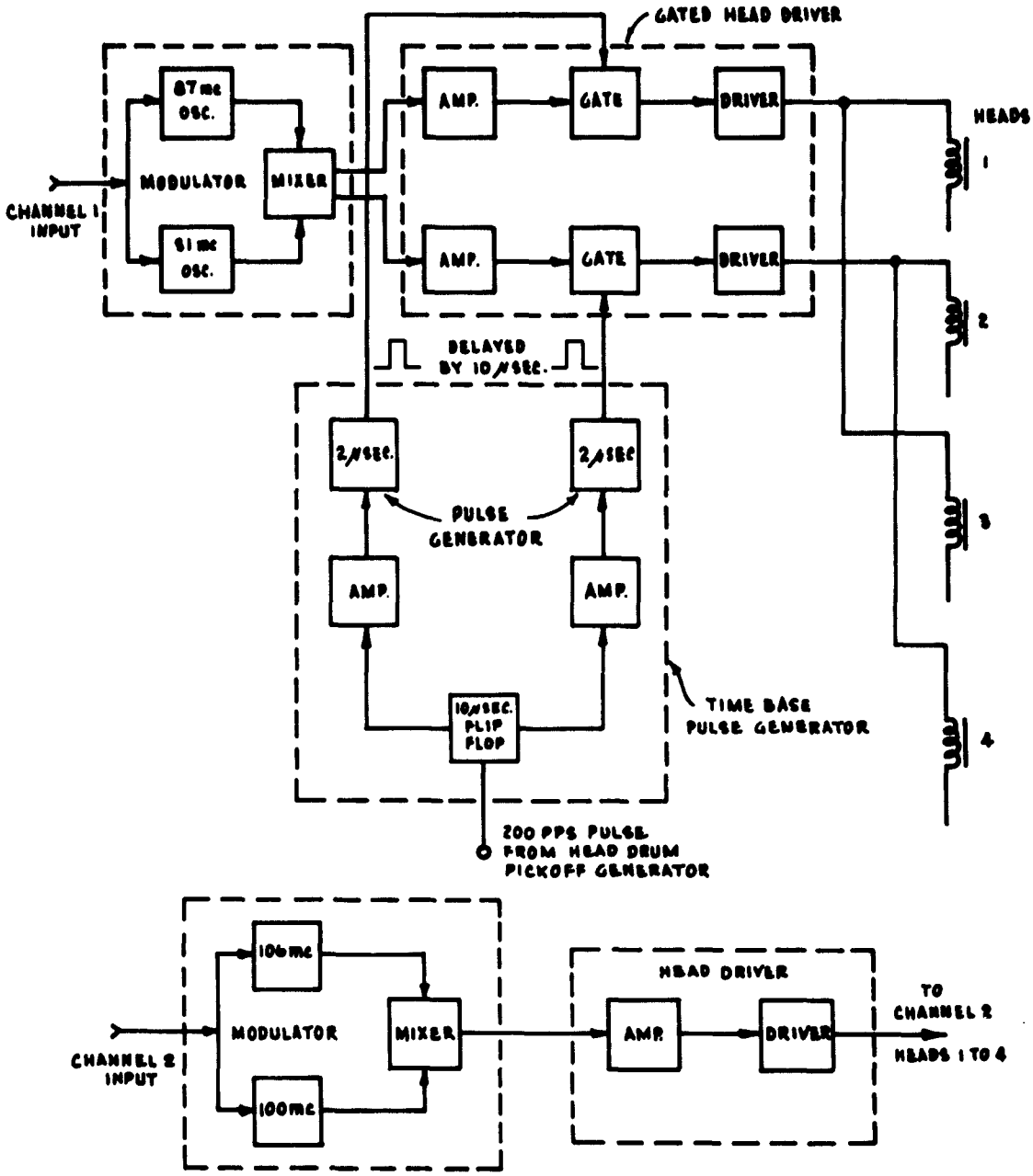


Figure 7. Block Diagram Wideband Record

The head/tape complex in this application does not respond to the upper sideband (i.e., high frequency sideband), however equalization prevents degradation of the recorded signal.

1.2.3.2 Head Drivers . . . The two gated head driver amplifiers for Channel 1 record are mounted on a single printed circuit card. Each amplifier drives two heads in parallel; one amplifier feeds heads 1 and 3, the other feeds heads 2 and 4. The gated head driver amplifiers amplify the signal from the modulator to a value suitable for application to the heads. They also apply two clamp marker pulses to the FM signal to enable timing of the head switching when the signal is being reassembled in the Reproduce mode. The marker pulses are timed to occur in the overlay period when heads 1 and 2 are in simultaneous contact with the tape (see Fig. 5). The reproduce electronic head switcher is designed so that no break in the reproduced signal is detectable. The single head driver amplifier for Channel 2 record drives all four heads in concert.

1.2.3.3 Time Pulse Generator . . . The time base pulse generator provides the two-microsecond marker pulses put on the recorded wideband signal in the gated head-driver amplifier. In the Record mode, the time base generator is triggered by the 200 pulse-per-second (pps) waveform from the rotary head drum pick-off head. In the Reproduce mode, the generator is triggered by the 200-pps waveform recovered from the reproduced wideband signal, and provides the reference signal for the signal switcher and the female guide servo to drive the guide motor and position the female guide to correct the tape stretch over the head tips.

1.2.4 Auxiliary Data Channel Record

The auxiliary data channel record amplifiers are mounted together with the control track record amplifier on a printed circuit card which plugs into the transport card rack. The two auxiliary data amplifiers are identical and provide the equipment with Direct Record facilities.

1.2.5 Reproduce Electronics (see block diagram, Fig. 8)

The reproduce circuitry consists of (1) the wideband reproduce circuitry, (2) the signal switcher, (3) the auxiliary reproduce circuitry.

1.2.5.1 Wideband Reproduce Circuitry . . . The wideband reproduce electronics are located in the switcher/servo box behind the transport (see Fig. 9). The circuitry consists of (1) a preamplifier; (2) a limiter, which reduces undesirable amplitude modulation of the signal caused by the varying sensitivities of the magnetic heads;(3) a demodulator, which provides full wave detection of the limited FM signal of the reproduce heads; and (4) post-amplifiers, which restore the reproduced signal to the amplitude at which it was recorded.

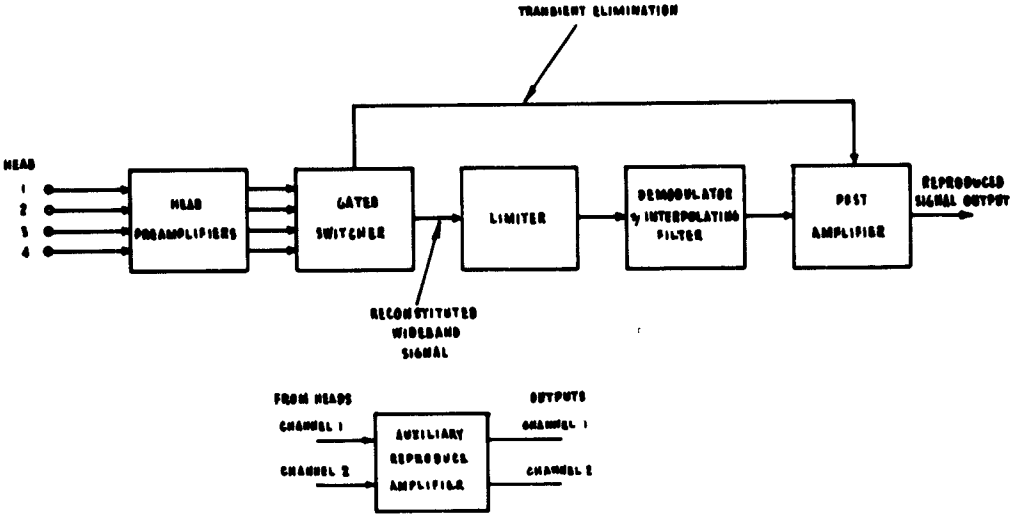


Figure 8. Block Diagram Reproduce Electronics

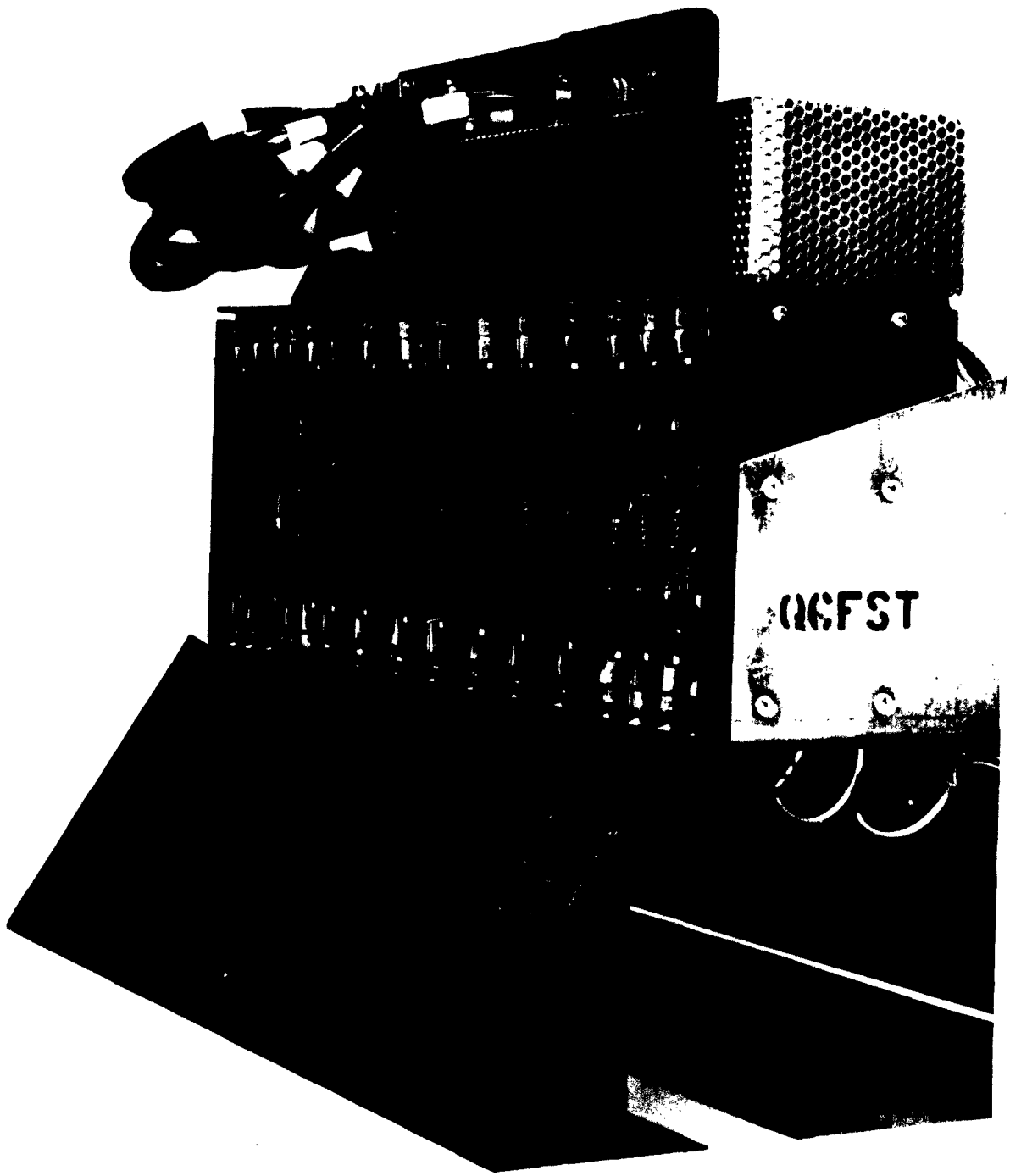


Figure 9. FR-700 Switcher/Servo Unit

1.2.5.2 Signal Switcher . . . The signal switcher reassembles the four separate amplified signals from the four separate reproduce heads into one signal corresponding to the original recorder input signal. The switcher circuitry consists of a switcher gated amplifier for each channel and a synchronized gate generator, all mounted on printed circuit cards plugged into the switcher/servo unit. Four preamplifiers, one for each head, provide wideband amplification for the low-level amplitude signal from the wideband reproduce heads before it is applied to the head switcher gated amplifiers. The preamplifiers circuit boards are plugged into the tape transport card rack.

1.2.5.3 Auxiliary Reproduce . . . The auxiliary channel reproduce circuitry provides for the reproduction of the two auxiliary tracks recorded on the tape with the wideband information. The amplifiers and equalizers are mounted on a single printed circuit card that plugs into the switcher/servo box. There is a printed circuit card for each channel.

1.2.6 Power Supply Bay

The equipment's regulated D.C. supplies, the head drum motor drive amplifier (MDA) and power supply, and the crystal-controlled frequency standard are all mounted in the power supply bay drawer immediately below the control bay. The main power on/off switch is on the face of the drawer.

1.2.6.1 Frequency Standard. . . Close control of the record/reproduce head drum speed is obtained by comparing the angular velocity of the head drum with the phase of the very accurate frequency standard and using any phase difference to correct the drum motor speed.

1.2.6.2 Motor Drive Amplifier . . . The 400-cps power of the head drum motor is frequency-stabilized by the MDA for a long-term accuracy of the head drum speed. The MDA provides a synchronized 120-vac, 400-cps sinewave power supply for the head drum drive motor. The MDA power supply outputs are 24 vdc, 12 amps unregulated for the MDA power output transistors, and 28 vdc for the transistors driving the power output transistors.

1.2.6.3 Regulated D.C. Power Supplies . . . The negative 24-vdc and the positive 24-vdc regulated supplies both supply the electronic circuitry and some relays which protect against regulated power supply failure. The supply will maintain its d-c output within 1 per cent of 24 volts, for an input variation of ± 6 per cent with a load of 3 amps over a temperature range of 25° - 85°C.

1.2.7 Static Frequency Changer

The static frequency changer converts the single-phase, 60-cps 115-vac input to three-phase, four-wire, 400 cps, 115 vac. The a-c capacity of the frequency changer is 800 va. The unit also has a 28-vdc, 9.5-amp output to power relays, indicator lamps and the MDA. The changer unit consists of a three-phase digital ring oscillator driving three separate square wave amplifiers, one for each phase. The square wave generated in each amplifier is converted to a sinewave of low harmonic content by means of a tuning filter at the output of each amplifier. Control of the output from each amplifier is effected by controlling the duration of the square wave in each driver amplifier. Each amplifier has a feedback amplifier which provides adjustable protection against short circuit or overload of a phase. The frequency changer is located in the drawer below the power supply bay.

1.3 REQUIRED MODIFICATIONS PER EXHIBIT RADC-5077A

1.3.1 Special Provisions

1.3.1.1 Paint . . . The equipment, with the exception of the transport, was painted in accordance with FED STD 595, Color No. 36176 (Air Force blue, semi-gloss).

1.3.1.2 Top-Mounted Junction Box . . . The FR-700 cabinet was modified to provide a top-mounted junction box, which contains remote control and remote indication connectors, wideband input/output and auxiliary input/output signal connectors, input line power connectors, fuses, and rf filter.

1.3.2 Wideband Signal Circuitry Modifications

1.3.2.1 Input Level and Impedance . . . The FR-700 wideband modulator circuit was modified from an input level of 2 volts p-p and an input impedance of 650 ohms to the specified 1.6 volts p-p and input impedance of 100 ohms. A level set control on the input in the form of a dual potentiometer was included to maintain the 100-ohm input impedance.

1.3.2.2 Output Level and Impedance . . . The post-amplifier circuit was modified to change the output level from 2 volts p-p, with a 20 to 50 ohm output impedance, to the specified 1.6 volts p-p, with a 100-ohm output impedance.

1.3.2.3 Transient Clamping and Filtering . . . The blocking oscillators were modified to provide a change in wideband signal clamping time during switching from 1 microsecond to the specified 0.5 microsecond ± 20 per cent.

1.3.3 Auxiliary Circuitry Modifications

Modification of the FR-700 auxiliary record amplifier was required to change the input impedance of +50K ohms to the specified 100 ohms. Modification of the FR-700 auxiliary reproduce amplifier was required to change the 1-volt rms output with a 600-ohm impedance to the specified 1-volt rms output with a 100-ohm impedance.

1.3.4 Control Circuitry Modifications

The FR-700 cabinet, control panel and control circuitry were modified for operation of the equipment from a remote station at a specified maximum cable distance of 125 feet with no degradation of performance. Control and indication for remote operation were provided as listed below; connectors were furnished at the top-mounted junction box.

CONTROL AND INDICATION

(1) Record (Start)
(2) Reproduce (Start)
(3) Fast Forward
(4) Rewind
(5) Stop

INDICATION ONLY

(1) Local Service
(2) Remote Control
(3) Record Confidence (Monitor)
(4) End-of-Tape
(5) 45-Second End-of-Tape Anticipation

1.3.4.1 Remote Indication of End-of-Tape . . . The FR-700 control circuitry was modified and a relay added to provide end-of-tape indication at the customer's remote panel. The relay is activated upon automatic stop and provides the required -24-volt indication voltage at the remote control plug on the J-box.

1.3.4.2 Remote End-of-Tape Anticipation Indication . . . End-of-tape anticipation indication was provided 45 seconds before the end of the tape by means of a tape pack radius sensing system (discussed in Para. 2.4.2).

1.3.5 RFI Suppression

The FR-700 shielding was effective but insufficient to meet MIL-I-26600, Class III requirements. The wideband modulator boards, the junction box, control panel, and rotary head assembly were the chief source of spurious radiation. Special shield boxes and filters were provided for the modulators; special shielding was provided for the control bay, junction box, and rotary head assembly; and a conductive glass door was provided for the transport. Equipment 101 successfully met the RFI specifications after these modifications. Equipments 102 and 103 were not RFI tested.

Equipment 104 was tested with the above modifications but failed to meet MIL-I-26600, Class III. Subsequent evaluation resulted in incorporation of additional card rack source shielding and filtering for the modulators and head drivers. A special inner card rack was designed with input and output perimeter filters for housing the head drivers and modulators. Retesting of Equipment 104 with these modifications was successful.

Equipments 101, 102, and 103 were retrofitted with these shield boxes, filters, and other radiation suppression modifications at the customer's installation. RFI suppression modifications and testing are discussed in Section 2.6.

1.4 DESCRIPTION OF AN/GLH-4 (XW-1) (See Figure 10)

A copy of the AN/GLH-4 equipment specification (SE-48000A) is provided in Appendix I for reference. Since the equipment is basically an FR-700, already described in Section 1.2, only a brief description will be given here.

Like the FR-700, the AN/GLH-4 is a fully transistorized wideband magnetic tape recorder/reproducer which meets the design intent of MIL-E-4158B. It consists of a tape transport assembly, power supplies, a printed circuit card rack, temperature control system, control unit, and frequency changer, all mounted in a cabinet approximately 95 inches in height (see Figure 10). Record, Reproduce, Stop, Fast Forward, and Rewind modes of operation are available. The equipment meets RF specification MIL-I-26600, Class III.

FM recording is used for the two wideband channels in the passband from 10 cps to 4 mc, and direct recording for the two auxiliary channels in the passband from 300 cps to 15 kc. Recording speeds are 25 ips for a half-hour of dual-track wideband and auxiliary recording, and 12.5 ips for an hour of single-track wideband and dual-track auxiliary recording. The method of recording is the same as that described in Section 1.2 above.

The wideband signal circuitry has been optimized for pulse response rather than standard frequency response (see Para. 2.2.3). Thus, the AN/GLH-4 has somewhat poorer high frequency (above 2 mc) characteristics than the standard Ampex wideband recorder/reproducer.

1.4.1 Machine-to-Machine Compatibility

The AN/GLH-4 is compatible with the AN/ALH-4 signal data recorder, the Model AR-300 wideband recorder, and the AN/GLH-3 (XH-1) wideband recorder/reproducer, as well as the FR-700. Tapes recorded on the AN/GLH-4 and reproduced on other compatible equipments will have the wideband amplitude linearly expanded from 1.6 volts p-p to 2 volts p-p. Frequency response will be ± 3 db from 10 cps to 4 mc, pulse response will be slightly degraded, and there will be a polarity inversion.

Tapes recorded on other compatible equipments and reproduced on the AN/GLH-4 will have the wideband amplitude linearly depressed from 2 volts p-p to 1.6 volts p-p. Frequency response will be ± 3 db from 10 cps to 2.5 mc and down less than 10 db at 4 mc. Pulse response will be similar to AN/GLH-4 specifications. There will be a polarity inversion.

1.4.2 Signal Connections

All input and output signal connections are made at a connector panel mounted between the cabinet's upper and lower rear doors. The wideband input level adjusts are also found on this panel. The auxiliary channels have parallel connections in the top-mounted junction box. Jumper cables are provided for series connection to the wideband input/output connectors, also located in the top-mounted junction box.

1.4.3 Transport Modifications

1.4.3.1 Tape Pack Follower Arm . . . The tape pack follower arm is used to light an indicator lamp on the customer's control panel in anticipation of end-of-tape. As the tape pack diminishes in thickness on the reel to the point where only 45 seconds of tape remain, the follower arm operates a microswitch, which completes the circuit to an indicator lamp on the remote panel. The speed selector switch in the control drawer selects the correct microswitch for the speed of operation.

1.4.3.2 Remote Control and Indication . . . Remote operation of the transport is provided when connections are made to the Remote receptacle on the top-mounted junction box. Record, Reproduce, Fast Forward, Rewind, and Stop modes are provided, plus indication of control status (Local Service or Remote Control), indication of end-of-tape, and indication 45 seconds before end-of-tape. Master control of the transport is retained at the equipment control panel until the Remote Control button is pushed, when control is transferred to the customer's remote panel. The equipment returns to the Stop mode and Local Service control status when end-of-tape is reached regardless of the operating mode or the control status. A record confidence monitor light indicates that the tape and drum rotation are at the proper speed, that the equipment is in the Record mode, that there is record current in the heads, and that the wideband heads are contacting the tape.

1.4.4 Record/Reproduce Electronics

The equipment specification (SE-48000A) provided in Appendix I outlines the signal requirements. The FR-700 modifications required to meet the specification are discussed in Section 2.2.

1.4.5 Frequency Changer

The static frequency changer converts the 120-vac, 50- or 60-cycle, single-phase line supply to 117 vac, 400 cps, three-phase for operation of the equipment.

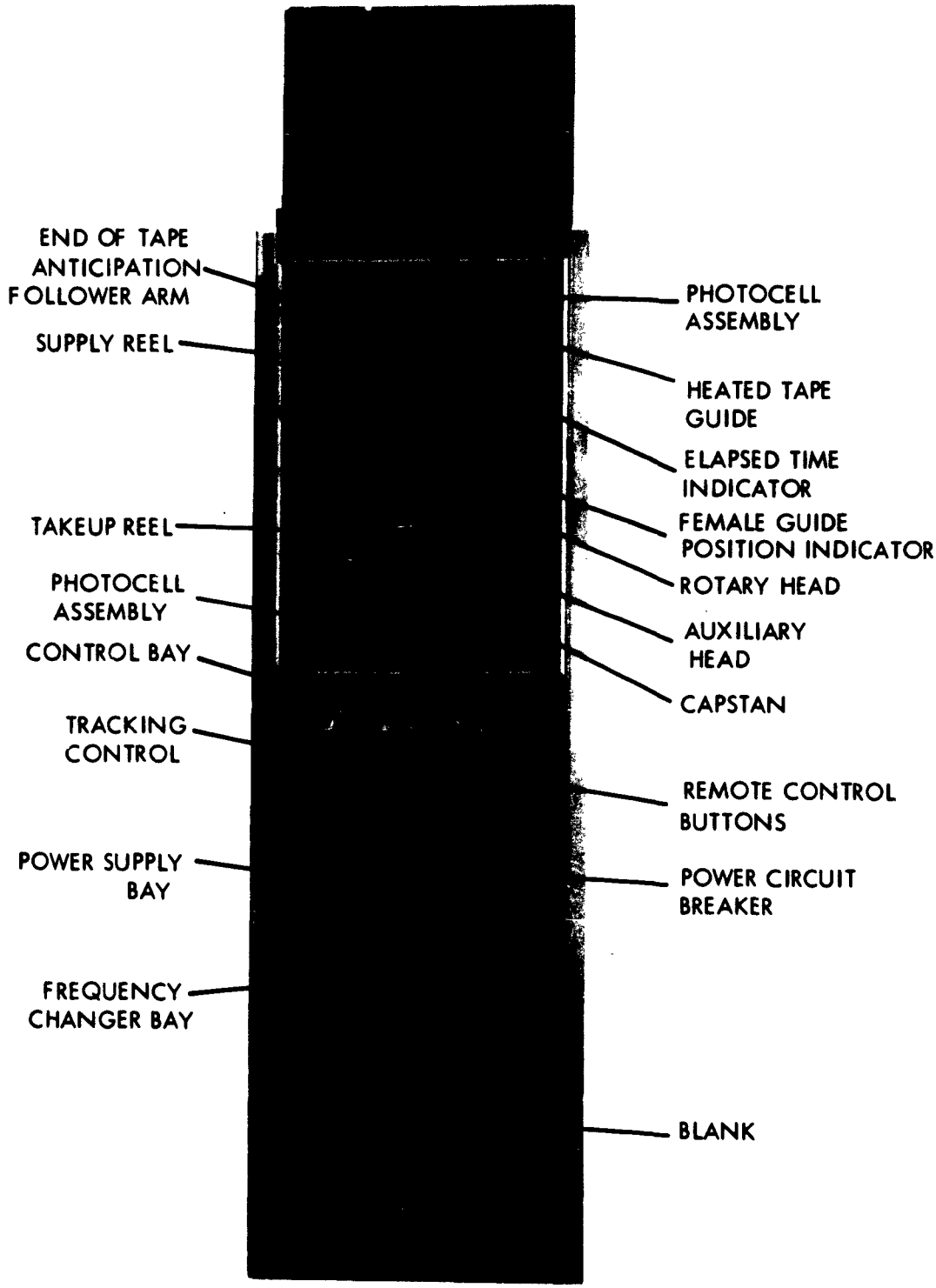


Figure 10. AN/GLH-4 Recorder/Reproducer, Arrangement of Sub-assemblies

2.0 DISCUSSION

2.1 JUNCTION BOX, DUBBING PANEL

The FR-700 cabinet was modified to provide mounting details and access to a top-mounted junction box. Stromberg-Carlson requirement prints, supplied by RADC, were used as the basis of the junction box design. By January 1961 the design was completed and the RFI shielding had been provided; routing of signal lines from existing terminations and controls to the junction box had been determined, and receptacles for remote control and indication, for signal input/output connections, and for power input had been selected. The types of connectors used and the terminations are described in the AN/GLH-4 (XW-1) Instruction Manual.

The wideband input level adjusts for Channels 1 and 2 and the connectors for dubbing are provided on the panel at the rear of the transport. The types of connectors used and the terminations are described in the Instruction Manual.

2.2 WIDEBAND SIGNAL CIRCUITRY

2.2.1 Modification of Modulators

It was decided that additional video amplifiers would not be required to provide the specified 1.6 volt p-p input signal level, since specifications could be met by modifying the existing modulator record amplifiers and incorporating a level set control (wideband input level adjust) in the panel at the rear of the transport to attenuate the input level and maintain the specified 100-ohm input impedance. The modulator circuits were modified to deviate a full 750 kc for the specified ± 0.8 volt. A dual potentiometer was used for the input level adjust to maintain the 100-ohm impedance. The heterodyne amplifier tank circuits were reversed to provide a polarity inversion to match the inversion caused by modification of the post-amplifiers. The input coupling capacitor was selected for optimized pulse response equalization.

2.2.2 Modification of Post-Amplifiers

The post-amplifiers were modified to provide sufficient power to deliver 1.6 volts p-p into a 100-ohm load and to provide an output impedance of 100 ohms. The output stage of the post-amplifier was redesigned as a common emitter rather than an emitter follower to maintain the 100-ohm impedance. The redesigned post-amplifier accommodates sinewaves in addition to plus and minus pulses.

2.2.3 Transient Clamping

Before the problems involved in reducing transient clamping time from 1.0 microsecond to the specified 0.5 microsecond can be understood, a description of the signal processing in the wideband reproduce circuitry must be given.

The switcher gated generator receives the output from the head pre-amplifiers in the form of four overlapping bursts of modulated carrier on four separate inputs. Because of this redundant overlapping, the signal cannot be directly reconstituted from these bursts. Therefore the switcher operates as a free running electronic switch which is "synced" once every fourth time by a signal reproduced from the redundant portion of one of the inputs. The output of the switcher is a continuous signal envelope of modulated carrier with transients at the switching points. The switcher also produces a 1-microsecond signal at the time of switching. This signal is developed by a blocking oscillator and transmitted to the post-amplifier, where it controls the transient clamp. The signal is passed through a delay line to compensate for the delay of the carrier signal in traversing the limiter, demodulator and post-amplifier. The modulated carrier is limited to remove the amplitude modulation and switcher transient peaks; however, the switcher transients remain as discontinuities in the carrier. The limited carrier is demodulated. The FR-700 type demodulator provides optimum sinewave response of ± 3 db from 10 cps to 4 mc. As an inherent part of this demodulation process, the signal is passed through a low pass filter to cut off the carrier feed-through frequencies above 4 mc. The switcher transient frequency discontinuity is processed by the demodulator and appears at the low-pass filter output as a spurious frequency.

The transient energy is spread over an increased period by this low-pass filter. Though the major portion of this transient is expended in less than 0.5 microsecond, the spurious components continue for a total period of up to 0.8 microsecond. This demodulated output is fed to the post-amplifier, where it is clamped for 1 microsecond, ± 20 per cent, to the level of the signal at the beginning of the clamp period to eliminate the transient from the signal output.

The clamping period was reduced from 1 microsecond to 0.5 microsecond by redesigning the blocking oscillator in the switcher. However, since the 0.5 microsecond clamp would not remove the entire switching transient, the low-pass filter also had to be redesigned to reduce ringing and pass the transient as a discontinuity of less than 0.5 microsecond duration. These modifications provided improved pulse response of 0.3 microsecond, with rise and decay times of 0.15 microsecond; however, redesign of the filter degraded the frequency response of the demodulator, particularly at the high end of the spectrum. Extensive redesign of the demodulator would have been required to re-establish the frequency response, assuming that such redesign could have been accomplished without creating additional problems in the reproduce circuitry. Since extensive redevelopment was not considered within the scope of the Contract, no further attempts were made to provide both flat sinusoidal frequency response and reduced clamping period.

2.2.4 Pulse Response Optimization

In March 1961 RADC agreed to optimization of the wideband signal circuitry for pulse rather than frequency response. Accordingly, Exhibit RADC-5077A was ammended to specify a video frequency response of 10 cps to 2.5 mc ± 3 db, down less than 10 db at 4 mc, as referenced to the signal level at 50 kc. Pulse response was specified as follows:

Input: rise time less than .02 usec from 10% - 90% amplitude level; decay time less than .02 usec from 90% - 10% amplitude level.

Output: rise time less than .18 usec from 10% - 90% amplitude level; decay time less than .18 usec from 90% - 10% amplitude level. Pulse width for constant amplitude to be a minimum .36 used.

In March 1961, investigation of the pulse characteristics of a standard FR-700 was begun. Pulse response pictures were obtained on an FR-700 modified with a linear phase filter in the demodulator. Rise and decay times of .18 microsecond were indicated, and pulses as short as 0.1 microsecond were reproduced with about half amplitude. These pictures were sent to RADC to demonstrate the characteristics of the equipment when optimized for pulse response. Performance testing of the first modified FR-700 (Serial No. 101) demonstrated that the wideband signal operation was well within the specifications.

Development work on the wideband signal electronics continued throughout the project. In April 1961 the record system was modified to utilize push-pull head drivers to reduce inter-channel modulation. The reproduce system was modified to balance the frequency response differences between the various heads, and effort was devoted to re-equalizing the preamplifier frequency response.

Some difficulty was experienced in providing reproduced pulses within the overshoot specification of Exhibit RADC-5077A (no greater than 10% of the pulse amplitude). The problem was attributed to frequency response variations of the individual head transducers, the record head drivers and modulators, and the reproduce amplifiers, limiters, demodulators, and post-amplifiers. The modulators, drivers, preamplifiers and post-amplifiers were adjusted for equalization to provide an improved pulse response and to minimize the deleterious effect which changing the head assemblies had produced on the system and on system interchangeability. Overshoot in excess of 35 per cent on Equipment 101 was reduced 10 to 20 per cent on Equipment 102. In July 1961 Ampex personnel visited Stromberg-Carlson in Rochester, New York, to retrofit Equipment 101 and thereby provide it with the improved pulse response. (The 101 equipment had been installed in a prototype AN/GLR-1 at Stromberg-Carlson for demonstration purposes.)

These modifications also reduced sinewave distortion over most of the band to approximately 3 per cent at 1 mc and less than 5 per cent at 3 mc. However, use of the linear phase filter to reduce ringing of the pulses increased distortion at 4 mc because it reduced the output of the 4 mc component but not of the 2 mc component that tends to distort it. The modification also increased the roll-off of frequency response at the low end of the band. The response was flat down to 20 to 25 cps but down more than the specified ± 3 db at 15 cps and down about 4 to 5 db at 10 cps. However, the RADC Exhibit indicates a minimum frequency of interest of 100 cps, therefore these deviations were considered acceptable. By the end of June 1961, development work on the wideband signal equalization was complete.

2.3 AUXILIARY CIRCUITRY

2.3.1 Record Amplifier

Investigation of the standard FR-700 auxiliary record circuitry revealed that the record amplifier had an input impedance greater than 50K ohms (specified value was 100 ohms). Modification was therefore made by the addition of a 100-ohm resistor across input to ground.

2.3.2 Reproduce Amplifier

The reproduce amplifier was modified by adding an emitter follower to provide an output impedance of 100 ohms. This solution proved unsatisfactory, however, because increasing the output impedance to 100 ohms caused excessive distortion when the signal level was raised to 1 volt rms. It was therefore decided to use transformer couplings, which provided a satisfactory solution.

2.3.3 Flutter

Reconcilliation of the contract flutter specification of 0.25 per cent rms, measured between 30 and 300 cps, and the FR-700 product specification of 0.04 per cent rms between 30 and 300 cps proved a difficult problem. The FR-700 exhibited flutter of 0.25 per cent normally, however it was necessary to ensure this performance. Any satisfactory solution required extensive redesign, and since the Exhibit precluded major modification, RADC agreed to change the flutter specification to agree with the FR-700 product specification.

2.4 CONTROL CIRCUITRY

The FR-700 provided back-lighted pushbutton controls for Record, Reproduce, Fast Forward, Rewind, and Stop modes. Local Service and Remote Control status indications were also required at both the local and remote panels. Modification of the FR-700 control bay drawer was made to install the wiring harness, terminal strip,

plugs, and relays required for the additonal control status functions at the local panel, and to route control functions and signal lines to the top-mounted junction box for remote operation of the equipment.

2.4.1 Control Logic

The following control circuit logic was planned:

(1) When operating from the remote station it should not be possible to operate from the local control except to stop by actuating the main power on/off switch.

(2) During pre-operation or service periods, control should not be available at the remote station.

(3) Both the remote and local stations should indicate the mode and status (location of control function) of the machine.

(4) The remote station should be provided with end-of-tape and end-of-tape-anticipation indications. End-of-tape should be anticipated 30 to 60 seconds before automatic stop. Record confidence (monitor) indication should also be provided.

(5) When the end of tape is reached the equipment should automatically return to local control. Control status should be transferrable only at the local station and only when the equipment is in the Stop mode.

2.4.2 End-of-Tape Anticipation Indication

Two methods of providing 45-second end-of-tape anticipation indication were developed. The first sensing system employed a follower arm to measure the radius of the pack on the supply reel and a microswitch to indicate the radius of the pack when there was 45 seconds of tape remaining until automatic stop.

The second sensing system employed a pick-up head within the supply reel drive to measure the frequency generated by the reel hub drive gear and a resonant reed relay to indicate when the frequency was analogous to 45 seconds of tape remaining. Since the capstan would be removing tape at a precise velocity, the frequency of the supply reel drive gear would be directly proportional to the radius of the remaining tape pack. A prototype of each system was built and evaluated.

Evaluation of the tape pack follower arm indicated that end-of-tape anticipation could be signaled consistently within the 30 to 60-second period with a setting stability on a given reel of better than ± 1 second. This method of anticipation indication was chosen for development. An improved follower arm for the production AN/GLH-4, developed in June 1961, reduced internal friction and improved operating precision by incorporating solenoids behind the transport to provide operating power. The arm remains retracted for all modes of operation except Record and Reproduce, when it engages automatically. (The tape pack follower arm is described in Para. 1.4.3.1.)

2.4.3 End-of-Tape Indication

End-of-tape indication at the remote station was provided by means of the FR-700 end-of-tape switch, which automatically stops the machine. A relay was added and the circuit modified. The relay actuates upon automatic stop to provide the specified -24 vdc voltage at the remote control connector on the junction box. An indicator lamp at the customer's remote station signals end-of-tape and return of the equipment to Local Service status.

To improve the reliability of the automatic stop switch, which could malfunction if its contacts were improperly cleaned, a second switch was located in the auxiliary head assembly on a parallel circuit. This second switch activates when the tape tension drops to a value of a few ounces or less due to tape breakage or end-of-tape.

2.5 START TIME

Exhibit RADC-5077A specified record and reproduce start time of 4 seconds or less, but the FR-700 start capability was 6 seconds. Efforts to reduce this time were made but no satisfactory results were achieved.

In Record mode, start time is the elapsed time between pushing the Record button and observing stable drum motor servo operation. In Reproduce, start time is the elapsed time between pushing the Reproduce button and observing stable switcher operation. In both modes the drum motor must come up to speed and the drum motor servo become stable. In addition, the capstan must come up to speed in Record, and the capstan servo become stable in Reproduce.

Continuous evaluation indicated possible means of reducing start time:

1. By providing a standby mode with the drum motor and capstan motor running, thereby reducing the time required for tape motion stabilization.

2. By starting the drum motor off one phase of the line frequency changer for several seconds to improve acceleration of the drum motor.

3. By employing an earlier version of the capstan motor to reduce time to stable motion.

The disadvantage of item 2 was that the drum motor would have to be shifted to operation off the frequency standard-controlled MDA, and time to synchronize this condition was required. The earlier version capstan motor reduced the time to synchronous capstan motor operation to about three seconds in the Record mode. In the Reproduce mode, however, an additional two seconds were required to lock in the capstan and switcher servos. Since no satisfactory solution appeared possible without extensive redesign of the drum motor and its drive components, and since redesign was beyond the scope of the Contract, RADC agreed to bring the AN/GLH-4 start time specification into line with the FR-700 6-second start time.

2.6 RFI SUPPRESSION

2.6.1 AN/GLH-3 Evaluation

An FR-700 production machine modified as an AN/GLH-3 prototype was used to determine the design modifications required to bring the AN/GLH-4 up to MIL-I-26600, Class III. Testing with this machine continued throughout the project.

Initial evaluations indicated that the existing FR-700 enclosure shielding was not sufficient to meet the specification. The major source of radiation appeared to be the wideband modulators, which heterodyne frequencies of 106 and 100 mc, and 81 and 87 mc to produce the 6-mc carrier frequency for the two wideband channels. It was thought that the modulator circuitry could be modified to bypass these frequencies and isolate them, and that the modulator boards could be redesigned to reduce or isolate the source of radiation to a point where it could be sufficiently attenuated by source shielding or the existing FR-700 enclosure shielding.

Modification of the modulator source shielding produced a marked change in output frequency; the 6-mc carrier frequency was shifted to 7.5 mc. However, sheathing the back of the modulator boards in a grounded copper sheet proved satisfactory in attenuating the radiation without affecting the output frequency. Bypassing the plus and minus B voltage to the ground also reduced radiation. These and other modifications, such as additional shielding in the card rack, improved shielding for the junction box, and conductive glass on the transport door to reduce radiation in the rotary head assembly were expected to bring operation within specification requirements.

Interface tests of the AN/GLH-3 held in February 1961 indicated that the modified equipment conformed to conductive interference requirements of the RFI specification and almost met the radiation interference requirements. Radiation interference was reduced to a point where only the 6-mc carrier frequency was beyond the specified 6 db level. Evaluations continued in an effort to reduce this to specification.

2.6.2 Preliminary RFI Acceptance Testing

2.6.2.1 Equipment 101 . . . In March 1961 Equipment 101 was sent to Filtron Company, Inc. of Palo Alto for preliminary RFI acceptance testing to MIL-I-26600, Class III. The results of this test are summarized in Para. 2.7.3.2 and detailed in the report of 3 April 1961, a copy of which is provided in Appendix III to this report. Radiated RFI was 5 db above specification due to excessive interference from the recording head and the control panel. Filtron recommended grounding the control panel and providing more adequate shielding of the record head. These recommendations were carried out. In addition, the control drawer was completely enclosed and a ground plane shield designed for the control button switchers. All wiring entering the control bay that was no longer needed (due to modification of the control circuitry) was removed, and the junction box was provided with better mounting and improved shielding. Equipments 102, 103, and 104 were modified the same as 101.

2.6.2.2 Equipment 104 . . . RFI testing of Equipment 104 to ST-48000 was carried out in August 1961 in an effort to prove out the modifications described above. Improvement in RFI suppression over Equipment 101 and full qualification to MIL-I-26600 were expected. The equipment seriously failed to qualify. Extensive retesting was begun but failed to divulge the reason for the failure, and examination of the prototype AN/GLH-3 test data did not indicate radiation to the extent found on Equipment 104. Design work was begun in an attempt to improve source suppression of the modulators and head drivers. The following modifications were made:

1. Head drivers and modulators were enclosed in a separate enclosed card rack within the transport card rack.

2. Feed-through perimeter filters were provided on all inputs to the cards within this special rack.

3. Improved shielding of the wideband head assembly was provided.

Equipment 104, with the prototype shielding and filters, was retested in September 1961 with complete success. It was determined that the head driver voltage should be maintained between 65 and 70 volts, rather than the 65 to 75 volts specified, to reduce the 6-mc radiated interference below specified limits. The final RFI test data on Equipment 104 are given in Appendix III.

2.6.2.3 Equipments 101, 102, 103 Retrofitting . . . Production shield boxes, filter assemblies and other modifications were designed for retrofitting units 101, 102 and 103, which had been previously shipped.

2.7 PRELIMINARY ACCEPTANCE TESTS

2.7.1 General Information

Preliminary Acceptance Test Procedure ST-48000 was written to the requirements of Equipment Specification SE-48000, Exhibit RADC-5077A, RFI specification MIL-I-26600, and the FR-700 System Test Procedure (included as Appendix A to ST-48000). Preliminary Acceptance Test data sheets for Equipments 101 - 104 are included in ST-48000 as Appendix C. SE-48000 is provided as Appendix I to this report, ST-48000 as Appendix II, and the RFI test reports on Equipments 101 and 104 as Appendix III.

In accordance with Exhibit RADC-5077A, the preliminary acceptance tests were conducted by Ampex and witnessed by the Air Force inspector. Three types of tests were conducted: (1) mechanical inspection tests; (2) electrical tests, including RFI suppression tests; and (3) mechanical and electrical performance tests. All tests were conducted at the prevailing ambient temperature and humidity conditions, as specified by the RADC Exhibit.

Test equipment is listed in Appendix A of ST-48000 (FR-700 System Test Procedure) and in Appendix B of ST-48000 (RFI test procedure).

2.7.2 Description of Tests Performed

2.7.2.1 Mechanical . . . Visual and mechanical inspection tests were conducted on all four units in compliance with SE-48000 and Exhibit RADC-5077A. These tests included (1) quality of material and workmanship, (2) identification markings in accordance with MIL-STD-130, and (3) color, exclusive of the transport, in accordance with FED-STD-595, color No. 36176.

2.7.2.2 Electrical . . . Electrical inspection tests included (1) power distribution of the frequency changer and power supplies; (2) control and indication function, including mode and status interlock functions, at both the local and remote

stations; (3) indication function of end-of-tape and end-of-tape anticipation at the remote station; (4) record confidence monitor function; (5) inherent circuitry soundness for both the wideband and auxiliary record/reproduce systems; and (6) RFI suppression.

2.7.2.3 RFI . . . Equipments 101 and 104 were tested to MIL-I-26600 Class III requirements. Test procedures and test equipment are detailed in the RFI test procedure, Appendix B of ST-48000. An illustration of the test facility and set-up is given in Figure 1 of the RFI test procedure. The purpose of these tests was to determine conformance of the equipment specimen to the radio interference requirements of the MIL-I-26600 specification, or to determine suppression measures required to reduce the interference generated by the specimen to a level acceptable to the specification.

2.7.2.4 Performance . . . Performance tests included (1) mechanical tests of tape speed, start and stop time, tape packing, and automatic stop; (2) electrical tests of the wideband output level, S/N ratio, frequency response, pulse response, fidelity of reproduced signal, switching transient amplitude and clamping period, crosstalk, linearity, and timing accuracy; and (3) electrical tests of the auxiliary output level, frequency response, S/N ratio, crosstalk, distortion, and flutter.

2.7.3 Results

2.7.3.1 Mechanical, Electrical, Performance Tests . . . Data sheets on Equipments 101 - 104 are included as Appendix C to ST-48000. In all cases the equipments met the performance specification and Exhibit RADC-5077A requirements. Mechanical and electronic improvements resulting from tests of Equipments 102 - 104 were provided on Equipment 101 by retrofitting at the Stromberg-Carlson factory in Rochester, New York (see Section 2.2.4).

2.7.3.2 RFI Tests . . . The results of the RFI tests on Equipments 101 and 104 are detailed in the reports provided in Appendix III of this document. On Equipment 101, broadband and CW conducted interference, broadband radiated interference, and susceptibility were all within the specified limits of the specification by 5 db, therefore it was considered that the speciman did not meet the interference requirements of the specification. The test facility commented that since most of the excessive interference was coming from the recording head and the control panel, the test sample would meet the radiated limits of the specification if the control panel were grounded and more adequate shielding were provided for the recording head. These and other modifications were made, as described in Section 2.6 of this report.

On Equipment 104, tested 8 October 1961, radiated and conducted interference and susceptibility measurements indicated that the equipment specimen met the radio interference requirements of MIL-I-26600.

2.8 RELIABILITY

Since each of the four equipments was individually modified in Engineering from production-built FR-700-1 recorder/reproducers, there was not adequate representation for reliability testing in accordance with Ampex Engineering Standard No. 10. Testing of the FR-700 itself was not considered within the scope and intent of the Contract.

The modifications required to convert the FR-700-1 to an AN/GLH-4 (XW-1) machine were subjected to evaluation during their development to ensure that the AN/GLH-4 equipment would not have degraded survival characteristics. It is anticipated that after the extensive check-out each equipment received in Engineering, which averaged 100 hours per machine, the specified service life outlined in SE-48000 and Exhibit RADC-5077A will be met.

2.9 MAINTAINABILITY

The AN/GLH-4 meets the maintainability requirements of Equipment Specification SE-48000 and Exhibit RADC-5077A. The cabinet provides easy access for adjustment of all assemblies. Most of the electronics are mounted on removable printed circuit boards, and the modular type mechanical assemblies may be replaced with a minimum of disassembly and readjustment.

Routine adjustments, trouble shooting and overhaul instructions are covered in the Instruction Manual supplied with the equipment.

3.0 CONCLUSIONS

The Recorder/Reproducer Set AN/GLH-4 (XW-1) described in this report meets the requirements of Equipment Specification SE-48000 and Exhibit RADC-5077A, Ammendments 1 and 2. It has been successfully preliminary acceptance tested to ST-48000 and meets the RFI suppression requirements of MIL-I-26600 Class III. Tapes recorded on this equipment may be reproduced on other equipments of the FR-700 family, and tapes recorded on these other equipments may be reproduced on the AN/GLH-4 (XW-1).

The wideband circuitry has been optimized for pulse rather than frequency response per the ammended Exhibit. Modification of the record modulators, addition of an input level adjust on the dubbing panel, and modification of the reproduce circuitry produced the specified 1.6-volt p-p input/output signal level and 100-ohm input/output impedance. The transient clamping period was reduced from 1 microsecond to 0.5 microsecond as specified. The modified circuitry provides a satisfactory frequency response, but frequency characteristics above 2 mc are somewhat poorer than in the standard FR-700 equipment.

Wideband and auxiliary signal connections have been provided at the dubbing panel on the back of the cabinet and duplicated at the top-mounted junction box. A remote connector on the J-box provides for operation from a customer-furnished remote station. In addition to the standard modes of operation, control circuitry logic provides for Remote Control and Local Service indications at both the local and remote panels, as well as record confidence (monitor) indication. End-of-tape indication and 45-second end-of-tape anticipation indication are provided at the remote panel.

APPENDIX I

ECN NO	BY	CHKD	AUTH	ISSUE	ECN NO.	BY	CHKD	AUTH	
REVISED	4-28-61	TWB.	T.W.B.						DRAWN BY
	3-26-1962								CHECKED BY
									SPEC. ENG.
									ENGINEER TWB 4
									APPROVED 28
									APPROVED TWB 4-1
									AUTHORIZED [illegible]

MILITARY SPECIFICATION

RECORDER/REPRODUCER SET, SIGNAL DATA

AN/GLH-4 (XW-1)

Ampex Data Products Company
Redwood City, California

T. W. Barger
Project Engineer
April 28, 1961

SE-43000 B

MILITARY SPECIFICATION

RECORDER-REPRODUCER SET, SIGNAL DATA

AN/GLH-4(XW-1)

1. SCOPE

1.1 SCOPE.- This specification covers a Magnetic Wideband Dual Track Recorder/Reproducer used for recording and reproducing signal data information.

1.2 The Model AN/GLH-4(XW-1) equipment shall be capable of recording one or two channels of information, each in the passband from 10 cps (Cycles per second) to 4 mc (Megacycles), and two channels of information in the passband from 300 cps to 15 kc (Kilocycles).

1.3 The Model AN/GLH-4(XW-1) equipment shall be capable of reproducing the above recorded information to provide one or two signal outputs from the 10 cps to 4 mc channels, and two signal outputs from the 300 cps to 15 kc channels.

1.4 During single wideband channel operation the record/reproduce time shall be one (1) hour, and during dual wideband channel operation the record/reproduce time shall be one-half (0.5) hour. During both single and dual channel operation the equipment shall provide two (2) 300 cps to 15 kc channels.

1.5 The equipment shall be optimized for pulse record/reproduce operation and provide switching transient clamping periods of 0.5 microseconds (nominal) or less.

1.6 The equipment shall be capable of remote control operation.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids form a part of this specification:

SPECIFICATIONS

Federal

CC-M-636	Motors, Fractional (Horsepower Alternating Current)

Military

MIL-R-11	Resistors, Fixed, Composition (Insulated)
MIL-T-27	Transformers and Inductors (Audio, Power and Pulse
MIL-V-173	Varnish, Moisture - and Fungus - resistant, for the treatment of Communications, Electronics, and associated Electrical Equipment.
MIL-E-4158	Electronic Equipment, Ground: General Requirements for.
MIL-E-4970	Environmental Testing, Ground Support Equipment, General Specification for.
MIL-T-5021	Tests; Aircraft Welding Operators' Certification
MIL-C-5756	Cable, Wire, Power, Electric, Portable
MIL-R-5757	Relays, Electric, Aircraft, General Specifications for.
MIL-M-8609	Motors, Direct-current, 28 Volt system, Aircraft, General Specification for.
MIL-D-9412	Data for Ground Support of Weapon Systems, Support Systems, Subsystems, and equipment.
MIL-Q-9858	Quality Control System Requirements
MIL-P-17555	Preparation for Delivery of Electronic Equipment, Miscellaneous Electrical Equipment (Except Rotating Electrical Equipment) and Associated Repair Parts
MIL-E-26431	Electronic Tuning Set AN/USQ-18(V).
MIL-I-26600	Interference Control Requirements, Class III.

STANDARDS

Federal

FED-STD-595	Colors

Military

MIL-STD-129	Marking for Shipping and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-415	Test Points and Test Facilities, Design Standards for.
MS 24139	Relay, General Purpose DC, 2 PDT

(Copies of specifications, standards, drawings and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 OTHER PUBLICATIONS.- The following non-Government documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

AMPEX STANDARDS

No.	Date	Title
IES No. 9		Definitions of Standard Terms
IES No. 10	8 July 1959	Reliability

AMPEX SPECIFICATIONS

No.	Date	Title	Issue
SP-48000	4-28-61	Product Specification Model AN/GLH-4(XW-1) 2 Channel Wideband Recorder/Reproducer	A
ST-48000	5-18-61	Test Procedure Specification, Preliminary Acceptance Test Procedure Model AN/GLH-4(XW-1)	D

AMPEX DRAWINGS

No.	Date	Title	Issue
F-48000	4-28-61	Final Assembly and Installation Drawing (All supporting detail drawings called out in F-48000)	A

10141-01		Floating Base Shipping Crate

AMPEX PUBLICATIONS

No.	Date	Title	Issue
48804-10	5-61	AN/GLH-4(XW-1) System Manual	

(Copies of Ampex Standards, Specifications, Drawings, Procedures and Publications may be obtained from the Ampex Corporation, Redwood City, California.)

NATIONAL ASSOCIATION OF RADIO AND TELEVISION BROADCASTERS STANDARD

N.A.B. (N.A.R.T.B.)	Recording and Reproducing Standards

(Copies of N.A.R.T.B. Standards may be obtained from the National Association of Radio and Television Broadcasters, 1771 North Street, North West, Washington 6, D.C.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION STANDARD

MG-1	Motors and Generators

(Copies of NEMA publications may be obtained from the National Electrical Manufacturer's Association, 155 East 44th Street, New York 17, New York.)

3. REQUIREMENTS

3.1 Components.- The AN/GLH-4(XW-1) Recorder/Reproducer Set shall consist of the following itemized units:

Item	Quantity	Description
1.	1 ea.	Transport Assembly
2.	1 ea.	Cabinet Assembly
3.	1 ea.	Control and Monitor Bay Assembly
4.	1 ea.	Frequency Changer Assembly
5.	1 ea.	Switcher/Servo Assembly
6.	1 ea.	Power Supply Assembly

7.	1 ea.	Side Panel, left
8.	1 ea.	Side Panel, right
9.	1 ea.	Cover Door Assembly
10.	1 ea.	Fixed Head Assembly
11.	1 ea.	Rotary Head Assembly with Servo Guide Adjustment
12.	1 ea.	Rotary Head Cover
13.	1 ea.	Top Mounted Junction Box Assembly

NOTE: For purposes of this specification, a component is a self contained element of a complete system or operating equipment, and is necessary for the operation of the system or equipment. It is normally a combination of parts, sub-assemblies, and assemblies; for example, amplifiers, modulators, and head assemblies. As used here, "component" doesn't refer to such things as resistors, capacitors, and relays.

3.2 GENERAL SPECIFICATION.- The requirements of Specification MIL-E-4158 apply as requirements of this specification with the exceptions and additions specified herein. When the two specifications conflict, this specification shall govern.

3.3 Selection of Specifications and Standards.- Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with Bulletin 143, except as provided in 3.3.1 and 3.3.2.

3.3.1 Commercial Parts.- Commercial parts having suitable properties may be used where, on the date of invitation for bids, there are no suitable standard parts. In any case, commercial utility parts like screws, bolts, nuts, cotter pins, etc., having suitable properties may be used provided:

a. They can be replaced by the standard parts (MS or AN) without alteration.

b. The corresponding standard part numbers are referenced in the parts list and, if practical, on the contractor's drawings.

3.3.2 Standard Parts.- With the exception in 3.3.1, AN and MS standard parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

3.4 Material.- In the selection of parts and materials, fulfillment of major design objectives shall be the prime consideration. In so doing, the following shall govern:

a. Parts and materials as approved by Specification MIL-E-4158 shall be given first consideration.

b. When the contractor can demonstrate that the use of standard AN or JAN parts or materials will not fulfill the design objectives because of size, weight, performance or other reasons, materials and parts shall be used which most nearly meet or which exceed the requirements of general specification.

3.4.1 Protective Treatment.- When materials are used in the construction of the Recorder/Reproducer equipments that are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service usage, they shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of this specification. The use of any protective coating that will crack, chip, or scale with age or extremes of climatic and environmental conditions shall be avoided.

3.5 Design.- The Recorder/Reproducer equipment is a wideband record/reproduce system using a two (2) inch wide 1.5 Mylar magnetic tape as a data storage medium. The system is designed for applications in such areas as Radar Reconnaissance, Radar Tracking, Training, Simulation of Effects for System Evaluation, Serial PDM, General Laboratory use, etc.

3.5.1 The equipment will simultaneously, accurately, and adequately record or reproduce two wideband data channels, each in the passband from 10 cps to 4 mc, and two auxiliary data channels, each in the passband from 300 cps to 15 kc. Also recorded are a 200 cps control track for the tape transport servo system and a monitor track as a part of a confidence indication circuit for proper transport operation.

3.5.2 The wideband data is recorded on the tape by means of Rotating Head Assemblies in a transverse pattern of tracks approximately 10 mils wide and 15.6 mils on center. Each of the two wideband channels is transcribed on the tape by one rotating drum consisting of four (4) record/reproduce heads mounted 90 degrees apart on the periphery of the drum. The axially mounted Head drums are rotating at a speed of 200 RPS to provide a Head to Tape velocity of approximately 1300 inches per second with respect to Head Tip radius.

3.5.3 Two tape speeds, 25 ips (inches per second), and 12.5 ips, shall allow either two wideband channel or one wideband channel record/reproduce operation at constant head drum velocity. During dual-wideband channel recording the two lateral tape tracks are interlaced.

3.5.4 The two auxiliary channels are recorded on the tape in a longitudinal pattern by means of a conventional record/reproduce head assembly. An erase head in this assembly provides for demagnetization of the tape's auxiliary track area prior to the time it passes the auxiliary head in record mode.

3.5.5 Record, reproduce, stop, fast forward, and rewind modes of operation shall be available and shall be controlled by operating back-lighted press buttons on the control panel. A frequency converter shall be mounted in the rack to convert 120 VAC, single phase, 60 cps line power supply into 117 VAC, 400 cycles, 3 phase power and 28 VDC as required by the equipment.

3.5.6 Remote control and local service control status shall be available and shall be controlled by operating back lighted push buttons on the equipment control panel.

3.5.7 All control functions shall be sufficiently interlocked to provide foolproof operation.

3.6 Construction. The equipment represents a fully transistorized, compact, self-contained wideband magnetic tape recorder/reproducer and shall meet the design objectives of MIL-E-4158 wherever practicable. Solid state components and etched circuit boards are used throughout the system in order to keep weight and volume to a minimum.

3.6.1 The recorder/reproducer equipment consists basically of a tape transport assembly, power supplies, a printed circuit board box, a temperature control system, a control unit, and a frequency converter, all of which are mounted on a specially designed enclosed cabinet providing ready access to the equipment from all sides. The tape transport assembly can be swung through 90 degrees for access to components mounted on the rear of the tape transport assembly and to the switcher/servo unit printed circuit board box mounted to the rear of the tape transport assembly. When in the closed position, the tape transport assembly is held in place by two locking type catches and the components on the face of the tape transport assembly are protected by a safety-glass, clear-view door.

3.6.2 The control unit is contained in a drawer immediately below the tape transport assembly with the controls mounted on the face of the drawer and accessible from the front of the cabinet. The drawer may be pulled out to provide access.

3.6.3 The regulated DC power supplies and the head drum motor drive amplifier and power supply are located in the drawer directly below the control panel. The main power On-Off switch is on the face of this drawer.

3.6.4 The solid-state frequency converter is mounted in the bottom drawer below the power supply drawer. The solid-state frequency converter provides 117 VAC, 400 cps, 3 phase, and 28 VDC from the 120 VAC, 60 cps, single phase main power supply.

3.6.5 Cooling air is circulated to all units from a filtered air intake located in the bottom of the cabinet. The cooling air is distributed to the upper units through a channel in the inside of the lower back cabinet door. Each of the upper units is provided with a separate blower for circulation of cooling air within the respective unit. There is no requirement for external cooling air other than the room ambient air.

3.6.6 The control circuitry is fitted with overheating protection devices which return the equipment to Power Off if overheating occurs (185°F). The overheating protection devices are self re-setting after the equipment cools off (175°F), allowing the equipment to be placed in Power On.

3.6.7 All input and output signal connectors are located on a panel located between the cabinet's upper and lower rear doors. Parallel connection is provided for the auxilliary channels in the top mounted junction box. The Wide Band signal inputs and outputs may be connected to the top mounted junction box connectors by a series jumper at the back panel.

3.6.8 Input power and remote control connectors are located in the top mounted junction box.

3.7 Performance. The equipment shall be a magnetic tape recorder/reproducer having the following capabilities:

a. The accurate recording of 1 or 2 wideband data channels, each in the passband from 10 cps to 4 mc.

b. Within the limits of specific interchangeability (see 6.5) the accurate reproduction (playback) of wideband data channels recorded by such equipments as:

(1) Ampex Recording Set, Signal Data AN/ALH-4 (XH-1)

(2) Ampex Airborne Wideband Magnetic Recorder, Model AR-300.

(3) Ampex Magnetic Wideband Dual Track Recorder/Reproducer, Model FR-700, Type I and Type II.

(4) Ampex Wideband Magnetic Tape Recorder/Reproducer Set AN/GLH-3 (XH-1).

(5) Ampex Wideband Magnetic Tape Recorder/Reproducer Set, Signal Data, AN/GLH-4 (XW-1).

c. The accurate recording of one or two auxiliary data channels, each in the passband from 300 cps to 15 kc.

d. The accurate reproduction (playback) of auxiliary data channels recorded by such equipments indicated in step (b) 1 through 5 above.

3.7.1 The performance requirements of this equipment shall be predicated on its capability of recording given electrical data of specified characteristics on a magnetic tape in such a manner that the recovered electrical data meets all pertaining requirements of this specification when it is being played back on the same or other equipment of this type in proper operating condition.

3.7.2 Electrical Power Requirements. The equipment shall operate with specified performance from a power source having the following characteristics:

System:	1 phase, 2 wire
Voltage:	120 Volts, RMS nominal, +10 Volts
Frequency:	47 cps to 53 cps, or 57 cps to 63 cps.

3.7.3 The power required by the equipment shall not exceed 2000 voltamperes. The equipment shall present an average power factor of not less than 0.80 lag.

3.7.4 Wideband Channels 1 and 2.

3.7.4.1 Wideband Channels Record

3.7.4.1.1 Input Impedance. The input impedance for channels 1 and 2 shall be as follows:

Channel 1	100 ohms ± 10% unbalanced
Channel 2	100 ohms ± 10% unbalanced

3.7.4.1.2 Nominal Input Level

Sinewave:	10 cps to 4 mc, 1.6 volts p-p nominal
Bipolar Pulses:	0.8 volt peak nominal Pulse rise time: ≤0.02 usec from 10% to 90% amplitude levels* Pulse repetition period shall be no greater than 1 mcs.
Unipolar Positive Going Pulses:	1.6 volts peak nominal Pulse rise time: ≤0.02 usec from 10% to 90% amplitude levels* Pulse rpetition period shall be no greater than 1 mcs. Note: This type of input represents an alternative providing a better signal-to-noise ratio for the case of complete absence of bipolar input signals. It requires a modulator carrier frequency of 6.75 mc instead of the normal 6 mc for sinewave or bipolar type inputs.

*Greater pulse rise times may be recorded but at a corresponding degradation in output risetime.

3.7.4.1.3 Input Sensitivity - With respect to the signal-to-noise and distortion specifications for the reproduced signals, the input signal level shall be within minus 0 db and plus 1 db from the nominal level.

3.7.4.1.4 Input Connections - Input connections shall be:

Channel 1	Connector J-256	Top Junction box
Channel 1	Connector J-175	Back junction panel
Channel 2	Connector J-258	Top junction box
Channel 2	Connector J-177	Back junction panel

Connector Type: Receptacle, female, UG290/U (BNC)

3.7.4.2 Wideband channels Reproduce

3.7.4.2.1 Reproduce Requirements - The following requirements shall be met when the equipment is in reproduce mode and set up with a reference tape recorded with carrier frequency with or without data modulation as required at both wideband channels at 25 ips or one wideband channel at 12.5 ips.

3.7.4.2.1.1 Output Impedance - The output load impedance for channels 1 and 2 shall be as follows:

Channel 1	100 ohms ± 10% unbalanced
Channel 2	100 ohms ± 10% unbalanced

3.7.4.2.2 Nominal Output

3.7.4.2.2.1 Nominal Output at 50 kc - With 50 kc sinewave modulation, the gain controls of both Post Amplifiers shall be capable of adjusting the 50 kc sinewave signal developed across the output load impedance of both wideband channels, respectively, to 1.6 v peak-to-peak nominal.

3.7.4.2.3 Signal-to-Noise Ratio - With carrier only, the remaining RMS noise level across the output load impedance of each wideband channel shall be 30 db or more below the nominal signal output level of 1.6 v peak-to-peak referenced to the signal level at 50 kc.

3.7.4.2.4 Frequency Response - With the carrier modulated with a sinewave in steps and intervals from 10 cps to 4 mc, the reproduced signal level developed across the output load impedance of each wideband channel shall not vary more than ±3 db from the particular signal level at 50 kc up to 2.5 mc and shall be down less than 10 db at 4 mc.

3.7.4.2.5 Pulse Response - The characteristics of a reproduced 100 kc, 1.6 v peak-to-peak, 0.02 microsecond rise time, square wave shall be:

a. Rise time - 0.18 usec maximum from 10% to 90% amplitude levels.
b. Decay time - 0.18 usec maximum from 10% to 90% amplitude levels
c. Overshoot - 10% of pulse amplitude maximum
d. Droop - less than 10% of pulse amplitude per millisecond
e. Output voltage - 1.6 volts peak-to-peak ±10% for pulses wider than 0.36 microsecond. Pulses of less than 0.36 microsecond may have reduced amplitude.
f. Undershoot - 10% of pulse amplitude maximum.

3.7.4.2.6 Fidelity of Reproducing Signals

Sinewave: Harmonic distortion shall not exceed 15% of 2nd and 3rd harmonic added vectorally, of 1 mcs signal.

Extraneous Frequencies: The amplitudes of extraneous frequencies

occurring during the reproduce process shall be less than 20% of the amplitude of the reproduced original frequency.

3.7.4.2.7 Switching Transient.- The amplitude of all switching transients, periodically occurring in time intervals of about 1250 usec. across the output load impedance of each channel and easily discernible when reproducing a reference tape with carrier frequency only, shall be clamped to and not be in excess of the peak noise level. The clamping period shall be 0.5 microseconds ± 20%.

3.7.4.2.8 Crosstalk Channel to Channel.- Reference tape to be recorded as follows:

a. Channel 1 - 50 kc, Channel 2 - shorted input
b. Channel 2 - 50 kc, Channel 1 - shorted input

When reproducing the above reference tape (see 6.4) the RMS signal and/or noise level developed across the output load impedance of the particular channel without 50 kc carrier modulation shall be 30 db or more below the nominal signal output level of 1.6 V. peak-to-peak.

3.7.4.2.9 Dynamic Linearity.- The signal level developed across the output load impedance of each wideband channel shall be within ± 0.5 db of the corresponding signal input record level throughout the potential range from 0.5 to 1.6 V. peak-to-peak nominal wideband record level at 50 kc sinewave.

3.7.4.2.10 Timing Accuracy of Two Reproduced Events.- The equipment shall be capable of reproducing two accurately recorded events of 1 millisecond time difference within ± 3 microseconds.

3.7.4.2.11 Output Connections.- Output connections shall be:

Channel 1 Connector J-257 Top junction box
Channel 1 Connector J-175 Back junction panel
Channel 2 Connector J-259 Top junction box
Channel 2 Connector J-179 Back junction panel

Connector Type: Receptacle, female UG290/U (BNC)

3.7.5 Auxiliary Channels 1 and 2

3.7.5.1 Auxiliary Channels Record

3.7.5.1.1 Input Impedance.- The input impedance for auxiliary channels 1 and 2 shall be as follows:

Channel 1	100 ohms ± 20% unbalanced
Channel 2	100 ohms ± 20% unbalanced

The above specified input impedances shall exist when the gain control of the pertaining auxiliary record amplifier is adjusted for nominal record current at nominal signal input level at 1 kc.

3.7.5.1.2 Input Level.- Nominal, 1 V. RMS sinewave at 1 kc

3.7.5.1.3 Sensitivity.- The potential input sensitivity of the auxiliary channels is dependent upon the tolerable total harmonic distortion of the reproduced output signal.

3.7.5.1.4 Input Connections.- Input connections shall be:

Channel 1 Connector J-170 Back junction panel
Channel 1 Connector J-254 Top junction box
Channel 2 Connector J-170 Back junction panel
Channel 2 Connector J-254 Top junction box

Connector Type: Receptacle, female, Bendix #SP02CE-10-6SW
Pin Connection: Channel 1; A and B (ground); Channel 2; C and D (ground)

3.7.5.2 Auxiliary Channels Reproduce

3.7.5.2.1 Reproduce Requirements.- The following requirements shall be met when reproducing a reference tape at either 12.5 ips or 25 ips tape speed, recorded as per the various requirements.

3.7.5.2.1.1 Output Impedance.- The output load impedance for channels 1 and 2 shall be as follows:

Channel 1	100 ohms ± 10% unbalanced
Channel 2	100 ohms ± 10% unbalanced

3.7.5.2.2 Output Connections.- Output connections shall be:

Channel 1 Connector J-171 Back junction panel
Channel 1 Connector J-255 Top junction box
Channel 2 Connector J-171 Back junction panel
Channel 2 Connector J-255 Top junction box

Connector Type:	Receptacle, female, Bendix #SP02CE-10-6S
Pin Connection:	Channel 1; A and B (ground)
	Channel 1; C and D (ground)

3.7.5.2.3 Nominal Output Level with 1 kc Sinewave - The gain controls of the auxiliary channels reproduce amplifiers shall be capable of adjusting the corresponding signal level developed across the load impedance of each channel, respectively, to 1 v. RMS nominal.

3.7.5.2.4 Frequency Response - Over the passband from 300 cps to 15 kc (sinewave) the signal output level across the load shall not vary more than ±3 db from the nominal signal output level at 500 cps.

3.7.5.2.5 Signal-to-Noise Ratio - The RMS noise level shall be 30 db or more below the nominal RMS signal level, at each channel, over the passband from 250 cps to 16 kc.

3.7.5.2.6 Crosstalk, Channel-to-Channel - Reference tape to be recorded as follows:

a. Channel 1 - 1 kc, Channel 2 - shorted input
b. Channel 2 - 1 kc, Channel 1 - shorted input

When reproducing the above reference tape (see 6.4), the RMS signal and/or noise level over the passband from 250 cps to 16 kc developed across the output load impedance of the particular channel without the 1 kc sinewave signal shall be 30 db or more below the nominal signal output level of 1 V. RMS at both tape speeds of 12.5 and 25 ips.

3.7.5.2.7 Distortion - Total harmonic distortion at 1000 cps shall not exceed 5%.

3.7.5.2.8 Flutter - The auxiliary channel flutter shall be no more than 0.4% RMS measured between 30 and 300 cps.

3.7.6 Tape Speed

3.7.6.1 Record/Reproduce Mode - Tape speed for record mode operation shall be:

a. One wideband channel operation 12.500 ips ±0.5%
b. Two wideband channel operation 25.000 ips ±0.2%

3.7.6.2 Fast Forward/Rewind Mode - Tape speed for fast forward/rewind mode operation shall be sufficient to wind 3800 feet of tape from one reel to the other in less than 4.3 minutes.

3.7.7 Record/Reproduce Playing Time - Playing time shall be 30 minutes minimum and 60 minutes minimum for two channel and one channel operation respectively with 3800 feet of tape.

3.7.8 Start Time - Start time to stable operation at either 12.5 or 25 ips shall be:

Record	6 sec maximum
Reproduce	6 sec maximum

3.7.9 Stop Time - Stop time from the indicated operation mode shall be:

Record (12.5 or 25 ips)	1 sec
Reproduce (12.5 or 25 ips)	1 sec
Fast Forward	3 sec
Rewind	3 sec

3.7.10 Operating Accoustic Noise Level - The operating accoustic noise level shall be no greater than 70 db above the reference intensity of 10^{16} watts/cm^2 or 0 db.

3.7.11 Tape Packing - The equipment shall be capable of taking up and packing 3800 feet of tape on the particular reel that is taking up and shall show no wrinkling or voids or excessive lateral displacement of the tape layers. There shall be no slippage in the tape pack when the end of 3800 feet of tape wound continuously, without stops, is pulled with force of 2 pounds.

3.8 Service Conditions - The design and the construction of the Recorder/Reproducer equipments shall be with the requirements of Specification MIL-E-4158 used as a design goal. Additionally, the Recorder/Reproducer equipments shall be designed and constructed to operate under any combination of the service conditions specified in the general specification with the exceptions and additions as follows:

3.8.1 Temperature - The effects of solar radiation shall be considered. The temperature limits listed do not include solar radiation.

a. Operating: 0°C. (32°F.) to +52°C. (125°F)
b. Non-operating and storage: -54°C. (65°F.) to +54°C. (130°F.)

3.8.2 Humidity - The equipments shall be capable of operation from zero to 90% relative humidity.

3.8.3 Altitude.- The equipments shall be capable of operation at an altitude of sea level to 10,000 feet.

3.8.4 Mechanical.- The equipments shall not suffer damage nor subsequently fail to provide the performance required in this specification after being subjected to a shock test in accordance with Procedure II or VII of Specification MIL-E-4970.

3.8.5 Vibration.- The equipment shall withstand shock and vibration in accordance with good commercial practice. Performance requirements are not specified when operating in the presence of vibration or shock.

3.9 Service Life.- The recorder shall be capable of a reliable operating life of at least 58 hours without requiring any servicing (see 6.2). The recorder shall have a minimum operating life of 24 hours a day for 6 months with only normal maintenance and without major overhaul (see 6.3). The recorder shall have a minimum operating life of 24 hours a day for 5 years with normal maintenance including major overhaul. Typically, this operating life consists of being turned on 24 hours a day but not in a tape handling mode for 24 hours a day. Tape handling mode operation typically will be 4 hours a day minimum. The Rotary Head Assembly shall have a minimum operating life of 100 hours without service other than cleaning. The Rotary Head operating life shall govern where there is conflict with the operating life specified above.

3.10 Tracking Control.- The manual tracking control shall be capable of adjusting the synchronism of the capstan and the rotating head drum so that the transverse time base pulses will be reproduced on the proper heads of Channel 1. The adjustment shall be sensitive enough to adjust the tracking for optimum output of the wideband heads and shall be stable enough not to require adjustment more often than prior to reproduction of a recorded tape.

3.11 Magnetization of Tape Contacting Components.- All tape handling components shall be free of magnetism. All heads shall be demagnetized before first operation and in case of degeneration of the reproduced signal.

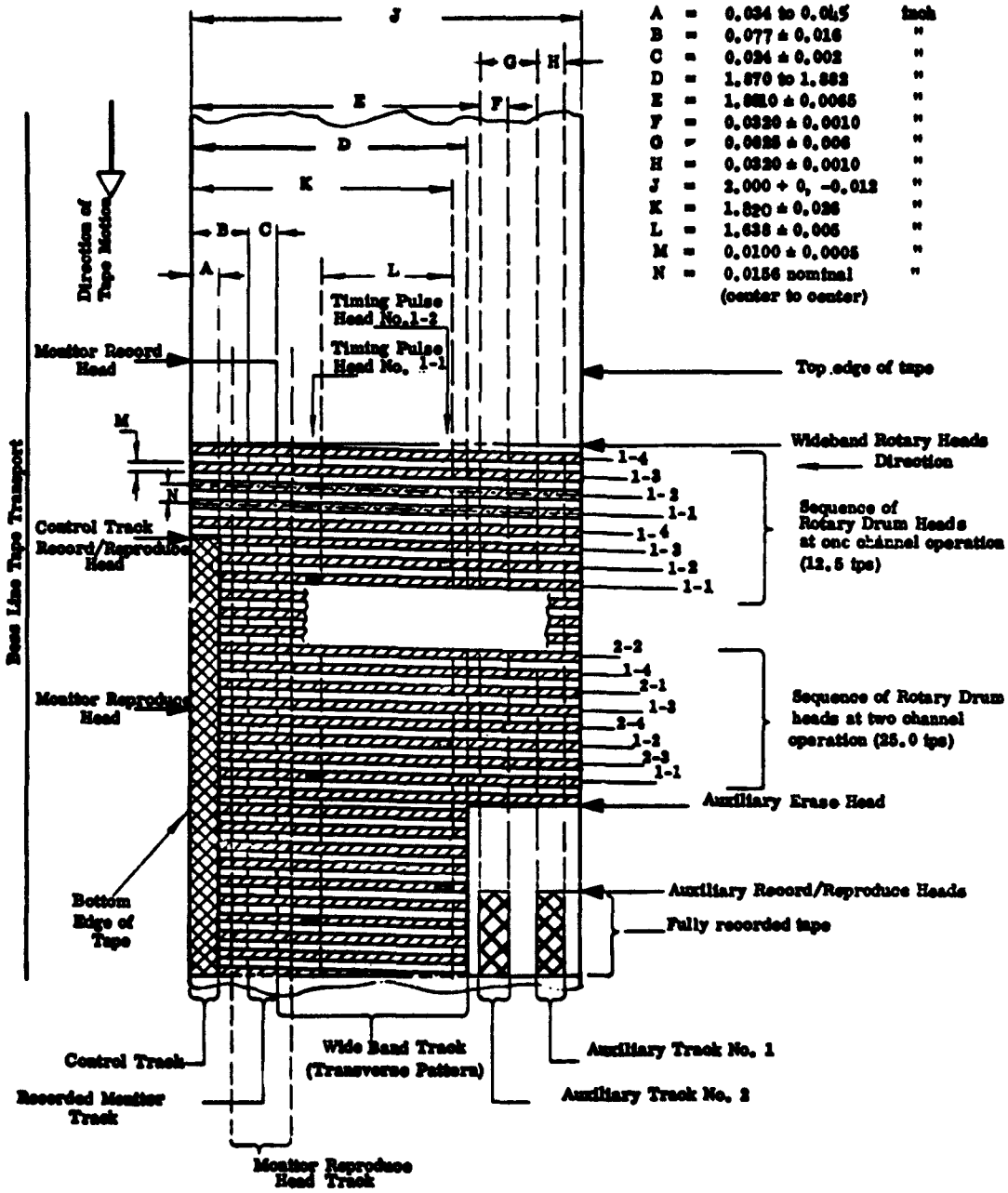
3.12 Tape Format Geometry.- The arrangement and dimensions of the magnetic tracks on the tape shall be as specified in Figure 1.

3.13 Pre-operation Warm up.

Figure 1

Arrangement and dimensions of the magnetic head tracks on the tape

SE-48000



Note: This figure shows the tape as viewed from the oxide side.

3.13.1 The main power switch (circuit breaker) shall not be turned on before the equipment has thermally stabilized at a temperature within the specified climatic temperature (see 3.8.1) and within 10°C. of the ambient temperature.

3.13.2 After power has been turned on at the main power switch (circuit breaker) a warm-up period of 10 minutes minimum shall be required before actuating the power On push button.

3.13.3 For operation other than checkout and adjustment, both side panels, both upper and lower rear doors, the transport card rack cover door, the transport cover door, shall be closed, all drawers shall be pushed fully in, and the head assembly cover shall be installed to insure proper thermal operation and air filtering.

3.14 Operating Position - The equipment shall be positioned within 10° of vertical for proper operation. The equipment shall be secured to the floor or to a base (not supplied) sufficient to safely allow the displacement of the equipment center of gravity that may occur if all drawers are pulled out and the transport assembly is swung out.

3.15 Magnetic Tape - The equipment shall use 2 inch wide Wide-Band instrumentation magnetic tape on 1 mil Mylar base as a data storage medium. Length up to 3800 feet may be handled on the transport. Tapes shall be degaussed prior to recording.

3.16 Tape Reel - The equipment shall use standard NARTB precision 10½ inch dia. x 2 inch reels. 2 inch NARTB reels of less flange diameter may be used with correspondingly reduced tape storage capacity.

3.17 Automatic Stop - The equipment shall return to the stop mode and local service control status when the end of the tape is reached when operating in any mode or either control status.

3.18 Record Monitor - A record confidence indicator shall be provided that will verify the following:

a. Tape at proper speed
b. Drum rotation at proper speed
c. Equipment in record mode
d. Presence of wideband channel carrier on the recording heads.

e. Wideband heads contacting tape.

3.19 Remote Control.- The equipment shall have provisions for being remotely controlled. The following control connections shall be provided at the top mounted junction box so that the recorder may be connected to a remote control station and be operated from a maximum cable distance of 125 feet (see 3.20) with no degradation of performance.

a. Record (start)
b. Reproduce (start)
c. Stop
d. Rewind
e. Fast Forward
f. Record confidence indicator (see 3.18)
g. End of tape indication as follows:

(1) A signal of +24 VDC shall be provided at least 30 seconds but not more than 60 seconds before the end of the tape is reached in record and reproduce mode.
(2) A signal of -24 VDC shall be provided as close in time to the end of the tape as possible.

3.19.1 Remote Control Connection.- The remote control connection shall be:

J-251, Top junction box, receptacle, female, Bendix PTO2CE-16-26S

3.20 Cable Set.- The cable set for the equipments shall be provided as necessary. Cable between the remote unit and the recorder shall not be provided but shall be specified and the maximum length of this cable will not exceed 125 feet.

3.21 Interchangeability.- All parts, components, and subassemblies of the equipments covered by this specification and bearing identical manufacturer's part numbers shall be functionally and dimensionally interchangeable. Assemblies requiring performance selection for proper functioning in connection with other assemblies are covered by assembly combination specifications and shall be excepted unless the combination consisting of two or more assemblies is considered as one interchangeable set. The drawing number requirements of Specification MIL-D-9281 shall govern changes in the manufacturer's part numbers.

3.22 Radio Interference Suppression (RFI).- The generation of interference by the equipment and the vulnerability of the equip-

ment to interference shall be controlled within the limits of Specification MIL-I-26600, Class III equipment.

3.23 Dimensions.- The overall dimensions for the equipment shall be as called out in figure 2 of this specification.

3.24 Weight.- The weight of the equipment shall be 675 pounds maximum.

3.25 Finish.- The following color shall be employed as being in accordance with Bulletin F49:

FED-STD-595 Color No. 36176 (Exclusive of the tape transport)

3.26 Identification of Product.- Equipment, assemblies, and parts shall be marked for identification in accordance with Standard MIL-STD-130.

3.27 Nomenclature and Type Designations.- Establishing of nomenclature and type designations shall be in accordance with Specification MIL-S-7513, subject to approval of the Air Force.

3.28 Workmanship.- The quality and standard of workmanship shall be in accordance with Ampex Quality and Workmanship Standards. Additionally, minimum sizes, weight, simplicity of operation, ease of maintenance, and an improvement in the performance and reliability of the specific functions beyond the requirements of this specification are objectives to be considered in the production of this equipment.

3.29 Reliability.- The required degree of reliability of the equipment shall be determined by its operational performance and service life requirements and shall be accomplished in accordance with Ampex Instrumentation Engineering Standard Number 10 on Reliability.

3.30 Signal Level Adjustment.- The equipment shall provide individual signal level adjustment for both in put and output for both wideband and auxiliary channels.

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of tests.- The inspection and testing of the Recorder/Reproducer Set, AN/GLH-4(XW-1) shall be classified as follows:

Acceptance tests.

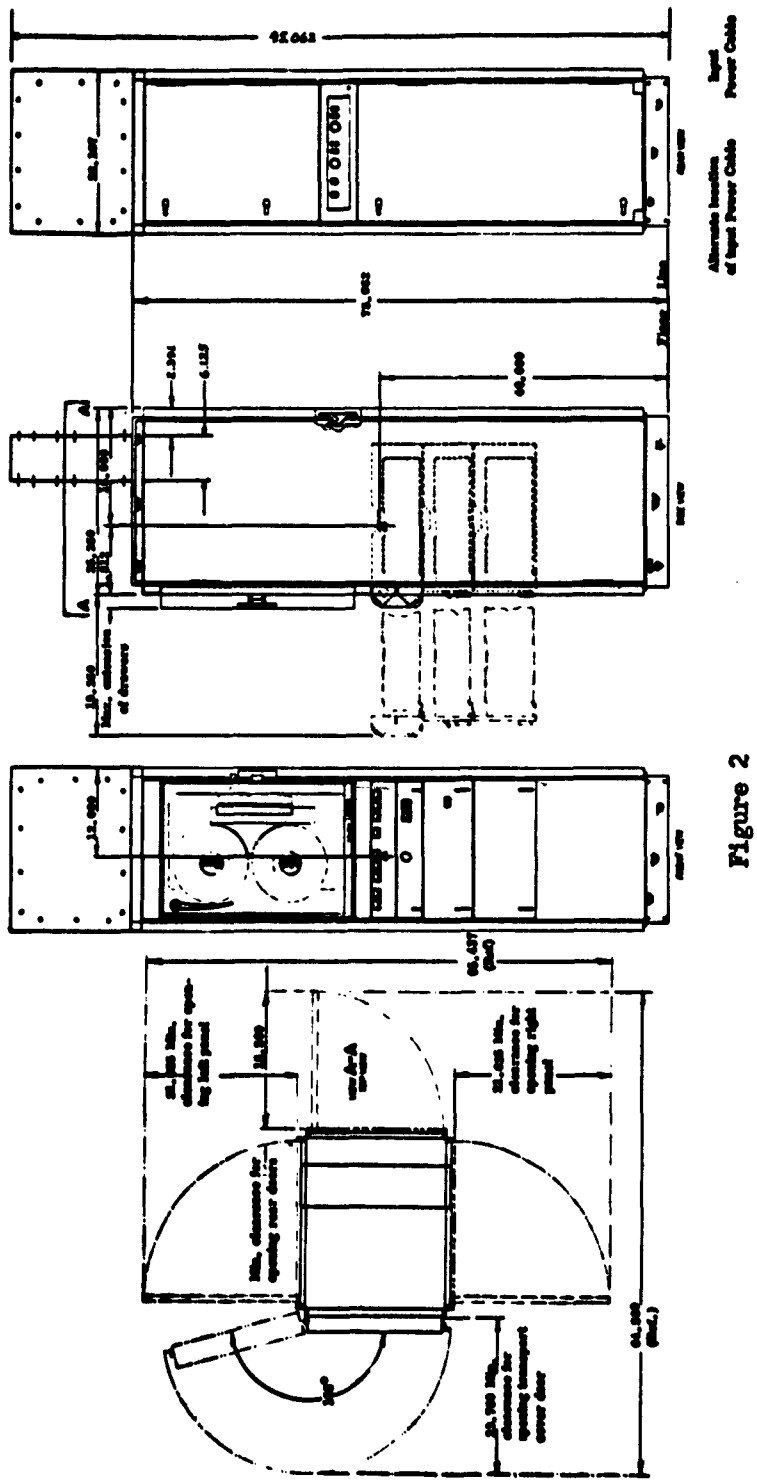


Figure 2

4.2 Acceptance tests.- Acceptance tests shall consist of:

a. Preliminary acceptance tests
b. Final acceptance tests

4.2.1 Preliminary Acceptance Tests.- The preliminary acceptance tests shall be conducted by the contractor at the contractor's plant and witnessed by authorized representatives of the procuring activity. The preliminary acceptance tests shall consist of:

4.2.1.1 Individual Tests.- Each Recorder/Reproducer Set, Signal Data, AN/GLH-4(XW-1) shall be subjected to the following tests as described uner 4.4, Test Methods, of this specification:

a. Mechanical Inspection Tests.- The equipment shall be given a thorough mechanical and visual inspection to determine that the quality of all materials and workmanship are in compliance with the requirements of this specification.

b. Electrical Tests.- The equipment shall be given all electrical tests necessary to confirm that all circuits are inherently sound and in compliance with the requirements of this specification.

c. Performance Tests.- The equipment shall be given all performance tests necessary to confirm that the equipments meet the performance requirements specified herein.

4.2.1.2 Sampling Tests.- One sample of Recorder/Reproducer Set, Signal Data, AN/GLH-4(XW-1) shall be selected at random from each lot and subjected to the tests listed below and described under 4.4, Test Methods, of this specification:

a. Radio Frequency Interference (RFI) Test - The equipment shall be tested for RFI in accordance with Specification MIL-I-26600, Class III equipment.

4.2.1.2.1 Lot size shall be determined by the procuring activity and shall not be less than 4 equipments.

4.2.2 Final Acceptance Test.- The final acceptance test, if conducted, will be conducted by the Government using Government personnel and facilities.

4.3 Test Conditions.- Unless otherwise specified, all tests required by this specification shall be made at prevailing ambient temperature and humidity conditions.

4.4 Test Methods

4.4.1 Examination of the product.- The equipment shall be examined to determine conformance with the requirements of this specification not covered specifically in the following test methods of this section. Mechanical, electrical and performance tests and inspections may include but are not restricted to the tests and test procedure specified in Ampex ST-48000, Test Procedures Specification, Preliminary Acceptance Test Procedures, Recorder/Reproducer Set, Signal Data, AN/GLH-4(XW-1).

4.4.2 Control, Local Station.- Control functions and inter locks shall be tested in accordance with the procedures under that heading specified in Ampex Test Procedure Specification ST-48000.

4.4.3 Wideband Signal Channels.- The following wideband channel characteristics shall be tested in accordance with the procedures under similar heading specified in Ampex Test Procedure Specification ST-48000:

a. Wideband Output Level
b. Wideband Signal to Noise Ratio
c. Wideband Frequency Response
d. Pulse Response
e. Fidelity of the Reproduced Signal
f. Switching Transient
g. Wideband Crosstalk
h. Dynamic Linearity
i. Timing Accurancy

4.4.4 Auxiliary Signal Channels.- The following auxiliary channel characteristics shall be tested in accordance with the procedures under similar heading specified in Ampex Test Procedure Specification ST-48000:

a. Auxiliary Output Level
b. Auxiliary Fequency Response
c. Auxiliary Signal to Noise Ratio
d. Auxiliary Crosstalk
e. Distortion
f. Flutter

4.4.5 Tape Transport.- The following tape transport characteristics shall be tested in accordance with the procedures under similar heading specified in Ampex Test Procedure Specification ST-48000:

a. Tape Speed
b. Start Time
c. Stop Time
d. Tape Packing
e. Automatic Stop

4.4.6 Record Monitor.- The Record Confidence monitor shall be tested in accordance with the procedure under that heading specified in Ampex Test Procedure Specification ST-48000.

4.4.7 Remote Control.- Remote control function, inter lock and indication shall be tested in accordance with the procedure under that heading specified in Ampex Test Procedure Specification ST-48000.

4.4.8 Radio Frequency Interference (RFI).- Radio Frequency Interference (RFI) shall be tested in accordance with the procedures specified in Appendix B to Ampex Test Procedure Specification ST-48000 and in accordance with the test methods specified in MIL-I-26600.

5. PREPARATION FOR DELIVERY

5.1 Preparation.- The recorder shall be prepared for shipment in accordance with the requirements of Specification MIL-P-17555, level A, except for those cases where special packaging for fragile equipment is required. The preparation shall be for overseas shipment but not for air shipment.

5.2 Marking for Shipment and Storage.- Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. The nomenclature shall be as follows:

RECORDER/REPRODUCER SET, SIGNAL DATA, AN/GLH-4(XW-1)

6. NOTES

6.1 Intended Use.- This recorder will be used to record Analog and Data Signals in Monitoring Set, Panoramic Data AN/GLR-1.

6.1.1 The auxiliary data tracks will be used to record and reproduce audio comments occupying the frequency range between 300 cps and 4000 cps frequency multiplexed with binary-coded-decimal digital data in the form of tone bursts, 12 kc tones for "ones" and 8 kc tones for "zeros", plused at a 1 kc rate with a 50% duty cycle.

6.2 Servicing - For the purposes of this specification, servicing shall be defined as any maintenance beyond the normal head cleaning or adjustment beyond the following:

a. Adjustment beyond twice a day
b. Adjustment of tape tracking phase adjustment other than prior to reproduction of a tape.

6.3 Major Overhaul - For the purposes of this specification, a major overhaul shall be defined as any repair or adjustment that involves more than 24 hours of actual labor or replacement of parts beyond the following:

a. The recording and/or reproducing heads
b. The transistors
c. One complete amplifier or sub-chassis
d. Normal preventive maintenance
e. One or more printed circuit boards

6.4 Reference Tape - For the purposes of this specification, a reference tape is a tape of the specified type (see 3.15) recorded with carrier frequency with or without data modulation as required at both wideband channels at 25 inches per second unless otherwise specified.

6.5 Recorded Tape Interchangeability - The AN/GLH-4 (XW-1) is one of a family of equipments (see 3.7.6) utilizing similar components and the same tape format geometry (see 3.12). Tape recorded on this equipment may be reproduced on other equipment of this family and tapes recorded on these other equipments may be reproduced on the AN/GLH-4 (XW-1). The performance requirements of these equipments are predicated on this type of interchangeability with the following exceptions:

(1) Tapes recorded on the AN/GLH-4 and reproduced on other equipment, [3.7b (1) through (4)], will have the wideband amplitude linearly expanded from 1.6 v peak-to-peak to 2.0 v peak-to-peak, frequency response will be ±3db from 10 cps to 4 mcs, and pulse response will be slightly degraded. There will be a polarity inversion.

(2) Tapes recorded on other equipments, [3.7b (1) through (4)], will have the wideband amplitude linearly depressed from 2 v peak-to-peak to 1.6 v peak-to peak, frequency response will be ±3cb from 10 cps to 2.5 mcs and down less than 10 db at 4 mcs, when reproduced on the AN/GLH-4 (XW-1). Pulse response will be similar to AN/GLH-4 requirements. There will be a polarity inversion.

NOTICE: When Government drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the facts that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

APPENDIX II

DESCRIPTION	DATE	AUTH.	ISSUE	DESCRIPTION	DATE	AUTH.
PROPOSED	2-20-61	TWB				
REVISED	3-13-61	TWB				
RELEASED	4-17-61	TWB				
REVISED	5-10-61	TWB				
REVISED	2-26-62	TWB				

	INITIALS	DATE
DRAWN BY		
CHECKED BY		
SPEC. ENG.		
ENGINEER	TWB	2-20-61
APPROVED	TWB	2-20-61
APPROVED		
AUTHORIZED	DHO	4-18-61

TEST PROCEDURE SPECIFICATION
PRELIMINARY ACCEPTANCE TEST PROCEDURES

RECORDER - REPRODUCER SET, SIGNAL DATA, AN/GLH-4 and (XW-1) (PROPOSED)

Ampex Instrumentation Products Company
Redwood City, California

T. W. Barger
Project Engineer
Engineering Project 759

March 13, 1961

ST-48000 E

1.0 Scope:

1.1 It is the intent of the enclosed procedure to provide test data to confirm preliminary compliance of the subject AN/GLH-4 (XW-1) to the requirements of Ampex Specification SE-48000, reference (6) below.

1.2 Reference Documents

(1) RADC Contract AF30(602)-2341
(2) RADC Exhibit 5077A, dated 10 June, 1960 (and Amendment No. 1 & 2)
(3) Military Specification, MIL-I-26600, Radio Frequency Interference
(4) System Test Procedure, Model FR-700, dated 14 February, 1961 (Appendix A of this procedure)
(5) Preliminary Radio Frequency Interference (RFI) Test Procedure (Appendix B of this procedure)
(6) Ampex Equipment Specification, SE-48000, Military Specification, Recorder-Reproducer Set, Signal Data, AN/GLH-4 (XW-1)
(7) Product Specification, SP-48000, AN/GLH-4 (XW-1)
(8) Data Sheet, Preliminary Acceptance Test AN/GLH-4 (Appendix C of this Procedure)

2.0 Test Equipment:

2.1 As specified in paragraph 2.0 of reference (5), appendix B of this procedure, and is listed under test equipment, pages 1 and 2 of reference (4), appendix A of this procedure.

2.2 Capstan motor speed sensor - SK-756-200.

2.3 Capstan speed sensor driver - SK-756-201.

3.0 Test Conditions:

3.1 All tests specified in this procedure are to be conducted at the prevailing ambient temperature and humidity conditions.

4.0 Test Procedure:

4.1 Mechanical Inspection Tests

4.1.1 The equipment shall be given a visual and mechanical inspection to confirm its compliance with reference (6). The tests will include, but not be restricted to the following:

4.1.1.1 Quality of material and workmanship

4.1.1.2 Identification marking in accordance with MIL-STD-130

4.1.1.3 Color of the equipment exclusive of the tape transport, in accordance with FED-STD-595; color number 36176.

4.2 Electrical Inspection Tests:

4.2.1 The equipment shall be given electrical inspection tests to confirm its compliance with reference (6). The tests will include, but not be restricted to the following:

4.2.1.1 Power Distribution

Conduct tests as indicated in paragraph 1.2.0 of reference (4), appendix A of this procedure.

4.2.1.2 Control and Indication Functions

4.2.1.2.1 Control, Local Stations

4.2.1.2.1.1 Control Function and Interlock

Conduct tests as indicated in paragraph 1.3.0 of reference (4), appendix A of this procedure, with the exception of 1.3.9 and 1.3.7.

4.2.1.3.1.2 Tape Pack Sensor

Press RECORD button and check that tape pack follower arm swings into contact with tape pack. Conduct similar test for REPRODUCE mode. Follower arm should return to its disengage position when the machine is placed in the STOP mode and should remain disengaged for all other modes.

4.2.1.2.2 Control Remote Station

Attach a simulated REMOTE STATION to the equipment utilizing a connecting cable 125 feet long and conduct the following tests:

4.2.1.2.2.1 Control Function and Mode Interlock

Place the equipment in REMOTE by pressing the back lighted push button on the local station and conduct tests as indicated in paragraphs 1.3.3, except do not operate the POWER ON button, 1.3.4, 1.3.5, 1.3.6, of reference (4), appendix A of this procedure.

4.2.1.2.2.2 Tape Pack Sensor

At the simulated REMOTE STATION conduct tests specified in 4.2.1.2.1.1 above.

4.2.1.2.2.3 Control Status Interlock

At the REMOTE STATION place the equipment succeedingly in each of its operating modes and for each mode, RECORD, REPRODUCE, REWIND, FAST FORWARD inspect that all push buttons at the LOCAL STATION are inoperative and that all buttons at the REMOTE STATION except STOP are inoperative. With the equipment in STOP, press LOCAL SERVICE button and at the LOCAL STATION place the equipment succeedingly in each of its operating modes, RECORD, REPRODUCE, REWIND, FAST FORWARD; inspect that all buttons at the REMOTE STATION are inoperative and that all buttons except STOP and POWER OFF are inoperative at the LOCAL STATION.

4.2.1.2.3 Control Indication.

Inspect that all indicating lights light at both stations to indicate the operating mode - STOP, RECORD, FAST FORWARD, REPRODUCE, REWIND, and operating status, LOCAL SERVICE or REMOTE CONTROL.

4.2.1.2.4 Remote Indication of Anticipation of End of Tape.

With equipment in REMOTE CONTROL, place the equipment in the RECORD mode and allow the tape to run off the supply reel. With a stop watch inspect that the END OF TAPE ANTICIPATION indication light lights 45 sec. ± 15 sec. before the equipment goes into the STOP mode. Inspect this with the TAPE SPEED switch set for both 12.5 inches and 25 inches.

4.2.1.2.5 Remote Indication of End of Tape

Rethread tape on the transport and place the equipment in the STOP mode. The END OF TAPE indication light should not light. Place the equipment in any mode and allow tape to run off of one of the reels. Inspect that the END OF TAPE indication light lights as the transport automatically goes into STOP.

4.2.1.2.6 Record Confidence Monitor.

Conduct tests as indicated in paragraph 1.3.7 of reference (4), appendix A of this procedure.

4.2.2 Optional
Electrical Inspection Tests.

4.2.2.1 Inherent Soundness of Circuitry.

Conduct tests as requested by representative of procuring activity to demonstrate circuits are inherently sound. These tests are not restricted to, but may include, any of the following from reference (4), appendix A to this procedure; paragraph 3.0.0, with the exception of 3.4.0, 3.5.0 and 3.6.0.

4.2.2.2 Radio Frequency Interference (RFI).

Conduct this test if requested by representatives of procuring activity to demonstrate compliance with MIL-I-26600, class III equipment in accordance with procedure in reference (5), appendix B of this procedure.

4.3 Performance Tests:

4.3.1 The equipment shall be given performance tests to confirm its compliance with reference (6). The tests will include, but not be restricted to the following:

4.3.1 (cont'd)

Mechanical Performance Tests (see 4.3.1.1)
Electrical Performance Tests (see 4.3.1.2)

4.3.1.1 Mechanical Performance Tests.

4.3.1.1.1 Tape Speed

4.3.1.1.1.1 Record and Reproduce.

Conduct tests as indicated in paragraph 2.1.3 of reference (4), appendix A of this procedure.

4.3.1.1.1.2 Fast Forward and Rewind.

Using a stop watch, confirm that the time period for fast forwarding and rewinding 3800 feet of tape is less than 4.3 minutes.

4.3.1.1.2. Start Time

4.3.1.1.2.1 Start Time RECORD mode.

Display on one trace of a two-trace oscilloscope the square wave output at pin 24 of TB-104. On the second trace display the output of the capstan speed sensor attached to the capstan motor. Sync oscilloscope externally on output at pin 24 of TB-104. With a stop watch confirm that the time period from pressing the RECORD button to obtaining a stable presentation of both traces on the oscilloscope is less than 6 seconds.

4.3.1.1.2.2 Start Time REPRODUCE mode.

Reproduce a tape with carrier only recorded and with a dual-trace oscilloscope observe the output of the switchers for channel one and channel two, with the oscilloscope externally synced to pin 24 of TB-104. With a stop watch confirm that the time period from pressing the REPRODUCE button to obtaining a stable output is less than 6 seconds.

4.3.1.1.3 Stop Time

4.3.1.1.3.1 Stop Time RECORD and REPRODUCE.

Using a stop watch, confirm that the time period from pressing the STOP button during RECORD or REPRODUCE to stopping of tape travel is less than 1 second for both 12.5 inch and 25 inch speed settings.

4.3.1.1.3.2 Stop Time FAST FORWARD and REWIND

Using a stop watch, confirm that the time period from pressing the STOP

4.3.1.2.1.5 Fidelity of Reproduced Signal.

Conduct test as indicated in paragraph 3.4.5 of reference (4), appendix A of this procedure.

4.3.1.2.1.6 Switching Transient

4.3.1.2.1.6.1 Amplitude

Conduct test as indicated in paragraph 3.4.7 of reference (4), appendix A of this procedure.

4.3.1.2.1.6.2 Clamp period

With an oscilloscope observe the output from pin Z of J-137 when reproducing a recorded tape. A pulse of 0.5 microseconds ±20% should be observed at approximately 1250 microsecond intervals.

4.3.1.2.1.7 Crosstalk

Conduct tests as indicated in paragraph 3.4.8 of reference (4), appendix A of this procedure, with the exception that 2 v p-p shall be 1.6 v p-p, 25 db shall be 30 db and 112 mv shall be 50 mv.

4.3.1.2.1.8 Dynamic Linearity

Conduct test as indicated in paragraph 3.4.10 of reference (4), appendix A of this procedure, with the exception that 1.6 v p-p shall be recorded and shall be used as a 0 db reference on reproduce instead of 2 v p-p.

4.3.1.2.1.9 Timing Accuracy

Conduct test as indicated in paragraph 3.4.9 of reference (4), appendix A of this procedure.

4.3.1.2.2 Auxiliary Signal Channel

4.3.1.2.2.1 Output Level

Conduct test as indicated in paragraph 3.5.2 of reference (4), appendix A of this procedure.

4.3.1.2.2.2 Frequency Response

Conduct test as indicated in paragraph 3.5.3 of reference (4), appendix A of this procedure, with the exception that 600 ohms shall be 100 ohms. and reference level of 1 KC shall be 500 cps.

4.3.1.2.2.3 Signal-to-Noise Ratio

Conduct test as indicated in paragraph 3.5.4 of reference (4), appendix A of this procedure, with the exception that 600 ohms shall be 100 ohms.

4.3.1.1.3.2 (cont'd)

button during FAST FORWARD or REWIND to stopping of tape travel is less than 3 seconds.

4.3.1.1.4 Tape Packing

Conduct tests as indicated in paragraph 2.1.2 of reference (4), appendix A of this procedure.

4.3.1.1.5 Automatic Stop

Conduct tests as indicated in paragraph 1.4.2 of reference (4), appendix A of this procedure.

4.3.1.2 Electrical Performance Tests

4.3.1.2.1 Wide Band Signal Channels

4.3.1.2.1.1 Output Level

Conduct tests as indicated in paragraph 3.4.2 of reference (4), appendix A of this procedure with the exception that output level shall be 1.6 v p-p and input connection shall be J-173, J-177, J-256, and J-258; output connections shall be J-175, J-179, J-257, and J-259; 50 and 90 ohm output shall be 100 ohms.

4.3.1.2.1.2 Signal-to-Noise Ratio

Conduct tests as indicated in paragraph 3.4.6 of reference (4), appendix A of this procedure with the exception that record level and reference level shall be 1.6 v p-p and -22 dbm or 63 mv shall be 50 mv.

4.3.1.2.1.3 Frequency Response

Conduct tests as indicated in paragraph 3.4.3 of reference (4), appendix A of this procedure, with the exception that deflection of all other frequencies shall be within ±3db only to 2.5 mc and shall be down less than 10 db at 4 mc.

4.3.1.2.1.4 Pulse Response

Record positive and negative going pulses of 1 microsecond width at a PRR of 100 KC, 0.8 v peak level. On REPRODUCE confirm the following:

Risetime	0.18 microseconds or less from 10% to 90% amplitude level
Decay time	0.18 microseconds or less from 10% to 90% amplitude level
Overshoot	10% of pulse amplitude maximum
Droop	less than 10% of pulse amplitude per millisecond
Output voltage	0.8 volts peak ±10%
Undershoot	10% of pulse amplitude maximum

4.3.1.2.2.4 Crosstalk

Conduct test as indicated in paragraph 3.5.5 of reference (4), appendix A of this procedure.

4.3.1.2.2.5 Distortion

Conduct test as indicated in paragraph 3.5.6 of reference (4), appendix A of this procedure with the exception that 2% and 3% shall be 5% and 500 cps shall be 1000 cps.

4.3.1.2.2.6 Flutter

Conduct test as indicated in paragraph 2.1.4 of reference (4), appendix A of this procedure.

5.0 Test Report:

5.1 A test report in accordance with MIL-T-9107 will be prepared at the completion of these tests.

APPENDIX A

SYSTEM TEST PROCEDURE, MODEL FR-700

Test Equipment
Engineering Section
Ampex Instrumentation Products Co.
Quality Control

TEST EQUIPMENT ENGINEERING SECTION - AMPEX DATA PRODUCTS QUALITY CONTROL
PROCEDURE VALIDITY CONTROL

TYPE OF PROCEDURE: SYSTEM TEST MODEL FR-700

( ) AREA OF USE: FINAL SYSTEMS TEST ASSY. NO. 66000

DESCRIPTION OF ITEM TESTED: Wideband Recorder/Reproducer SCHEM. NO. ---

PROCEDURE REVISION CONTROLLED BY: Product Spec. SPEC. NO. SP-66000

PROCEDURE CHANGES AND CORRECTIONS AS FOLLOWS: PROCEDURE COPIES RELEASED

DATE REV.	PAGES OR SECTIONS EFFECTED & ISSUE LETTER OF VALID REVISED PAGES	DRAWING/E.O. ISSUE ASSY.	SCHEM.	SPEC.	ENGR.
1/23/61	INITIAL RELEASE OF PROCEDURE			B	CHT
2/14/61	Pages 3 through 20 revised eliminating one page			B	RLB
	ST-48000	Page 10 of 52			

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST EQUIPMENT

Item	Quan	Description	Model
1	1	Audio Oscillator	HP-200 CD
2	1	Wideband Oscillator	Tektronix 190A
3	1	Square Wave Generator	HP 211
4	1	Electronic Counter	CMC Model 226A
5	1	Variable Filter	SKL 302
6	1	Oscilloscope	Tektronix 545
7	1	Preamplifier	Type CA
8	1	Preamplifier	Type L
9	1	Probe, Green Tip, 50:1	Tektronix P-450-L
10	1	Probe, Brown Tip, 10:1	Tektronix
11	1	Grid Dip Meter	Millen 90651
12	1	Audio Wave Analyzer	Donner 2100
13	1	RF Wave Analyzer	Sierra 121
14	1	RF Wave Analyzer	Sierra 158
15	1	VTVM	HP-400-D
16	1	Multimeter	Triplett 630-A
17	1	Flutter Bridge	D & R FL-4
18	1	Speaker Amplifier	Ampex Model 620
19	1	Microphone	
20	1	3800 ft Roll 2 in Tape	Ampex 752011
21	2	Precision Reels	Ampex 28050-03
22	1	Stop Watch	Minerva 144
23	1	Spring Tension Gauge	Chatillon
24	1	Tape Tension Measuring Bracket	Z-99799
25	1	3 Track Tape Reproducer	Z-99793
26	1	3 Track Multiplexer Tape	Z-99795
27	1	Multiplexer Switching Unit	Z-99796
28	1	Wideband Calibrated Speed Test Tape	Z-99791
29	1	Wideband Speed Test PEC Sensor Head	Z-99792

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST EQUIPMENT

Item	Quan	Description	Model
30	1	Speed Test Driver Unit	Z-99794
31	1	Crystal Calibrator	Z-99790
32	1	Cable Set, Multiplexer/Demultiplexer	Y-99789
33	1	Cable Set	Y-99797

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

1.0.0 PRELIMINARY

1.2.0 Power

With Triplett 630-A multimeter and oscilloscope, verify the power distribution as follows:

1.2.1 Frequency Changer

Output A: 24.5 to 31.5 v DC, 560 mv RMS ripple max. (Measure with multimeter).

Output B: Each line to ground 110.4 v to 119.6 v RMS. Voltage difference between phases must not exceed 2.0 v RMS

1.2.2 Power Supplies

Output C: TB 204 terms 3 and 4 (ground) 26.5 v to 29.5 v DC.

Outputs D & F: TB 201 terms 4 and 5 (ground) 23.75 v to 24.25 v DC.
Ripple 30 mv P-P max. with no load (Measure with scope).

Output E: TB 204 terms 5 and 4 (ground) 22.5 v to 25.5 v DC.

Output G: TB 202 term 5 and 4 (ground) -23.75 v to -24.25 v DC
Ripple 30 mv P-P max. with no load (Measure with scope).

1.3.0 Control Functions

1.3.1 Operate the POWER ON button and check that the tape transport and power unit blower motors start up. Check that the lamps in tape quantity sensing photo cell housings come on.

1.3.2 Operate the POWER OFF button and check that the power to the equipment is removed.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

1.3.3 Operate the POWER ON button Press the FAST FORWARD button and check that the tape is rapidly wound from the supply reel onto the takeup reel. Check that the tape guiding is even. Check that the REWIND and RECORD buttons are inoperative.

1.3.4 Press the STOP button. Check that the tape is brought to a standstill smoothly, without tape loops being thrown.

1.3.5 Press the REWIND button and check that the tape is rapidly and smoothly wound onto the supply reel from the takeup reel. Check that the FAST FORWARD and RECORD buttons are inoperative.

1.3.6 Press the STOP button and check that the tape is brought to a standstill smoothly, without loops being thrown.

1.3.7 Press the RECORD buttons. Check that the rotary head drum turns over immediately. Check that the tape is now transported and the female guide automatically closes. Check that the MONITOR indicator is illuminated. Swing the female tape guide away from the rotary head assembly and check that the MONITOR indicator extinguishes. Reinstate the female guide and check that the MONITOR indicator is illuminated. Check that the tape is guiding properly. Check that the FAST FORWARD and REWIND buttons are inoperative. Press the STOP button and check that the RECORD mode ceases and that tape is brought smoothly to a standstill.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

1.3.8 Set the TAPE SPEED switch to 25. Press the RECORD button and visually observe the tape speed. Press the STOP button and set the TAPE SPEED switch to 12-1/2 inches. Press the RECORD button and visually check that the tape speed is approximately half of the 25 inch speed. Press the STOP button.

1.3.9 Check that the dial on the female guide adjustment is set at 9. Set TAPE SPEED switch at 25.

1.4.0 Tape Transport

1.4.1 Place recorder in the RECORD mode and observe that no excessive tape curling or sidewise motion of the tape occurs at the guides, capstans or the heads. No deterioration of performance should result during reproduction due to the above.

1.4.2 Place transport in any drive or fast wind mode so that tape runs off one reel. Check that automatic stop mechanism stops transport.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

2.0.0 PERFORMANCE TESTS

2.1.0 Tape Transport

2.1.1 Operating Times

Using a stop watch, check the following time periods:

a.	From STOP to stable operation in RECORD or REPRODUCE:	6 secs. max.
b.	From RECORD or REPRODUCE to STOP:	1 sec. max.
c.	From FAST FORWARD or REWIND to STOP:	3 sec. max.
d.	From RECORD to REPRODUCE (Time to elapse after actuation of STOP button):	10 secs. min.
e.	From REPRODUCE to RECORD (Time to elapse after actuation of STOP button):	10 secs. min.
f.	From RECORD or REPRODUCE to FAST FORWARD (Time to elapse after actuation of STOP button):	1 second
g.	From FAST FORWARD or REWIND to RECORD or REPRODUCE (Time to elapse after actuation of STOP button):	1 sec. min.
h.	From FAST FORWARD to REWIND (Time to elapse after actuation of STOP button):	1 second
i.	From REWIND to FAST FORWARD (Time to elapse after actuation of STOP button):	1 second
j.	FAST FORWARD wind time for 3800 ft:	4.3 Minutes Max.
k.	REWIND time for 3800 ft.:	4.3 Minutes Max.
l.	From actuation of RECORD or REPRODUCE button to engagement of Female Guide	2 secs. max.

2.1.2 Tape Packing

Using a reel of tape which has been wound continuously in FAST FORWARD or REWIND, measure packing tension with a spring gauge. A pull of 24 ounces should cause not more than 0 inch of slippage at the end of 3800 feet of tape. Check at the end of both forward and rewind modes.

The wind should leave no wrinkles or holes in the packed tape.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

2.1.3 Speed

Using the wideband calibrated speed test tape (Z-99791) and P.E.C. sensing head (Z-99792) together with an electronic counter and a speed test driver unit (Z-99795), verify the tape speed in the RECORD mode. The measured period between markers should be:

12.5 IPS 9.95 to 10.05 seconds

25.0 IPS 9.98 to 10.02 seconds

NOTE: The tape tension must have been verified before conducting this test. (Section 1.4.2)

2.1.4 Flutter

Record a section of 14.5 KC from FL-4 Flutter Bridge oscillator on one auxillary channel at both 12.5 ips and 25 ips.

Replay this tape and measure the RMS flutter with the D & R type FL-4 flutter bridge.

Should not exceed 0.4% RMS at either speed for Bandpass 30 - 300 cps.

2.1.5 Install tape temp card, adjust and remove. To be packaged and shipped with machine.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.0.0 ADJUSTMENTS

3.1.0 Record Wideband

3.1.1 Modulator

With a Millen 90651 Grid Dip Meter, verify the frequency of the high frequency oscillator of the -1 Modulator and the low frequency oscillator of the -2 Modulator as follows:

-1 H.F. Osc: 34.4 - 89.6 Mc. (87 Mc ± 3%)
-2 L.F. Osc: 97 Mc - 103 Mc. (100 Mc ± 3%)

Using a crystal calibrator, Z-99790, calibrate the horizontal display of a scope so that 10 cycles of 6 Mc (or 5.25 Mc) exactly equals 10 cm. Remove calibrator and connect scope to one of the -1 Modulator output test points. Adjust L8 for a carrier frequency giving 10 cm scope display.

Change probe to output of -2 Modulator and adjust L4 for correct carrier frequency.

3.1.2 Carrier Level

Verify that the carrier voltage, as measured at the head slip ring contacts, is 60 v P-P minimum at each head of both rotating drums.

Adjust the modulator output level controls, R24 and R25, if necessary.

3.1.3 Timing Pulse Position

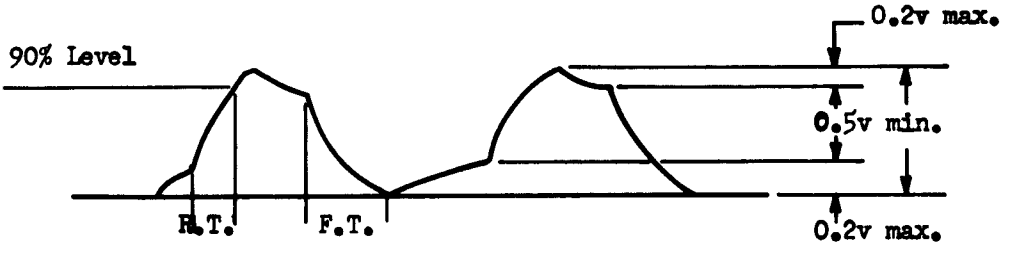
3.1.3.1 The carrier as observed at TP-1 of the Gated Head Driver in J-124 of Wideband Channel #1 should have timing pulses superimposed upon it as follows:

Pulse Rise Time (leading edge) p. 2 μ sec. max.
Pulse Fall Time (trailing edge) p. 3 μsec. max.
Pulse Width (50% amplitude) 1.5 - 3.0 μsec.

MODEL PR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.1.3.2 When played back, the pulses should be positioned so that the distance between the beginning of the carrier output from dime 2 to the beginning of the first pulse is approximately equal to the distance between the beginning of the second notch and the end of the carrier output from dime 1.

3.1.4 Control Track Record
Inspect TP-4 of the Control Track Amplifier in J-115. The signal waveform must conform to the figure below:



Rep Rate 200 cps synchronous with frequency standard.
R. T. 30 μsec. max.
F. T. 150 μsec. max.

3.2.0 Reproduce Wideband

3.2.1 Female Guide Servo
With the equipment in STANDBY, verify that the manual Female Guide control will actuate the guide servo motor so that the Indicator reads between 0 and 18.

When playing back a previously recorded tape, the guide should show evidence of normal operation by showing a small amount of to and fro motion.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.2.2 A.M Pulse Detector
Replay a tape recorded with carrier only (no signal input) and inspect terminals W and D of the A.M. Pulse Detector at J-134.

Adjust the gain controls R1 and R17 so that the detected timing pulses from heads 1 and 2 have an optimum shape (i.e., maximum pulse amplitude and minimum noise.)

3.2.3 Switcher Gated Amp and Switcher A.F.C.
Set controls R1, 11, 18 and 25 of the Switcher Gated Amplifier to midrange.

Replay a tape recorded with carrier only and inspect Terminal Z of J-138 with a scope. The scope should be triggered from the phase comparator output terminal provided in the rear of the equipment.

Adjust the Switcher AFC control R40 so that the reproduced carrier is continuous and not broken into four sections.

Adjust the Switcher Gated Amplifier controls R1, 11, 18 and 25 so that the carrier output is 1 v P-P at all points.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.2.4 Tracking
The manual tracking control should be capable of adjusting the tracking so that the recorded timing notches will be reproduced by heads 1 and 2 of drum 1.

3.2.5 Control Track Reproduce
Reproduce a pre-recorded tape and inspect TP-1 of the control track reproduce amplifier (check at both operating speeds).

A spiked waveform should be observed. Rep. rate 200 P.P.S. amplitude 0.7 v P-P min.

Inspect TP-2. A square wave should be seen. Rep. rate 200 cps, amplitude 30 v P-P min., rise and fall times 10μsec. max., droop 10% max.

3.2.6 Head Drum Servo
Replay a pre-recorded tape and inspect Head Drum Phase Comparator output with a scope. (Pin at rear of AM Pulse Detector Connector on Switcher Card Rack.)

A 400 cps square wave should be observed symmetrical within 10%. The V.F.O. frequency control may be varied slightly to correct symmetry.

Any jitter exhibited by the square wave should not exceed 30μsec. P-P. If this value is exceeded, adjust R-6 on Head Drum Phase Shifter card to bring into specification.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3 2.7 Capstan Servo

Replay a pre-recorded tape and inspect the input terminal of low pass filter FL-103. A waveform conforming to either Figure 1 or 2 should be seen

Figure 1

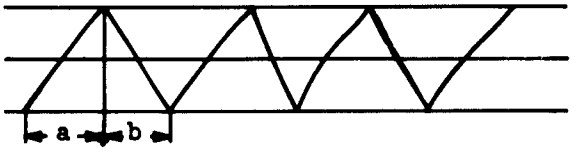
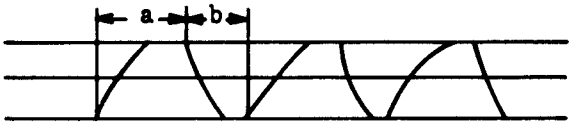


Figure 2



Frequency - 400 cps approx.
Ratio - a/b = 0.9 to 1.1

The waveform may exhibit slight to and fro motion, but this should not be rhythmical at a frequency of 8 to 10 cps.

3.3.0 Record Auxiliaries

3.3.1 Record Current

Remove both modulators and the bias and erase oscillator (J-125, 126 and 113).

With the equipment in the RECORD mode, measure the record current in each channel across the pertaining 10 ohm resistors on the Auxiliary Record amplifier board in J-115.

Should be 0.7 ma RMS nominal (7mv across 10 ohms) with an input level of 1 v RMS at 1 Kc.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.3.2 Bias

Reinsert the bias and erase oscillator board in J-113 (leave both Modulator boards out) and inspect the bias signal across one of the 10 ohm resistors on the Auxiliary Record Amplifier board in J-115.

Current should be 11 ma RMS minimum (110 mv across 10 ohms), 14 ma RMS max.

Distortion should be 3.2% (30 db down - Measure with Sierra 121).
Frequency should be 100 Kc - 120 Kc (measure with counter).

3.3.3 Erase

Measure the Erase current across the 10 ohm resistor on the bias and erase oscillator board in J-113.

Current should be 110 ma minimum (1.1v across 10 ohms).
Distortion should not be evident on a scope.

3.4.0 Wideband

3.4.1 General

a. All tests in this section should be conducted on both channels.
b. All the recordings called for in the following sections may be consecutive if desired. Voice comments may be used to identify each section.
c. When sine wave recording is desired, use an HP-200-CD oscillator and Tektronix 190A constant-amplitude signal generator to cover entire frequency range.

MODEL FR-7000
SYSTEM TEST PROCEDURE

TEST SPECIFICATION

3.4.2 Levels

Apply a 50 Kc sine wave signal of 2v P-P to the wideband inputs. Record a short section of tape and replay same. Output level should be 2 v P-P after adjustment of post amplifier gain controls (R-7).

This test should be repeated for all four inputs, J-172, 173, 176 and 177.

All four outputs J-174, 175,178, and 179 should be examined for output level. The difference between the 50 ohm and 90 ohm outputs should not exceed 1 db. (1.78 v to 2.25 v on a 2.0 v ref.)

3.4.3 Frequency Response

Record a length of tape with the following sine wave frequencies in sequence: 10 cps, 50 cps, 100 cps, 500 cps, 5 K cps, 10 K cps 50 K cps, 100 K cps, 1 Mc, 2 Mc, 3 Mc, 4 Mc.

Using a VTVM, hold the input constant at -1 ohm for all frequencies.

Replay this tape, and, using the same VTVM, measure the output levels. With the 50 Kc level adjusted for -1 dbm, the deflection of all other frequencies must be within $\pm$3 db.

3.4.4 Rise Time

With a HP 211 square wave generator (75 ohm output) set to 100 Kc, 2v P-P, record a short section of tape.

Replay and measure rise time (10% - 90% amp).

Should be 0.18 microseconds or less.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.4.5 Distortion
Record a section of tape with a 1.0 Mc., 2v P-P signal.

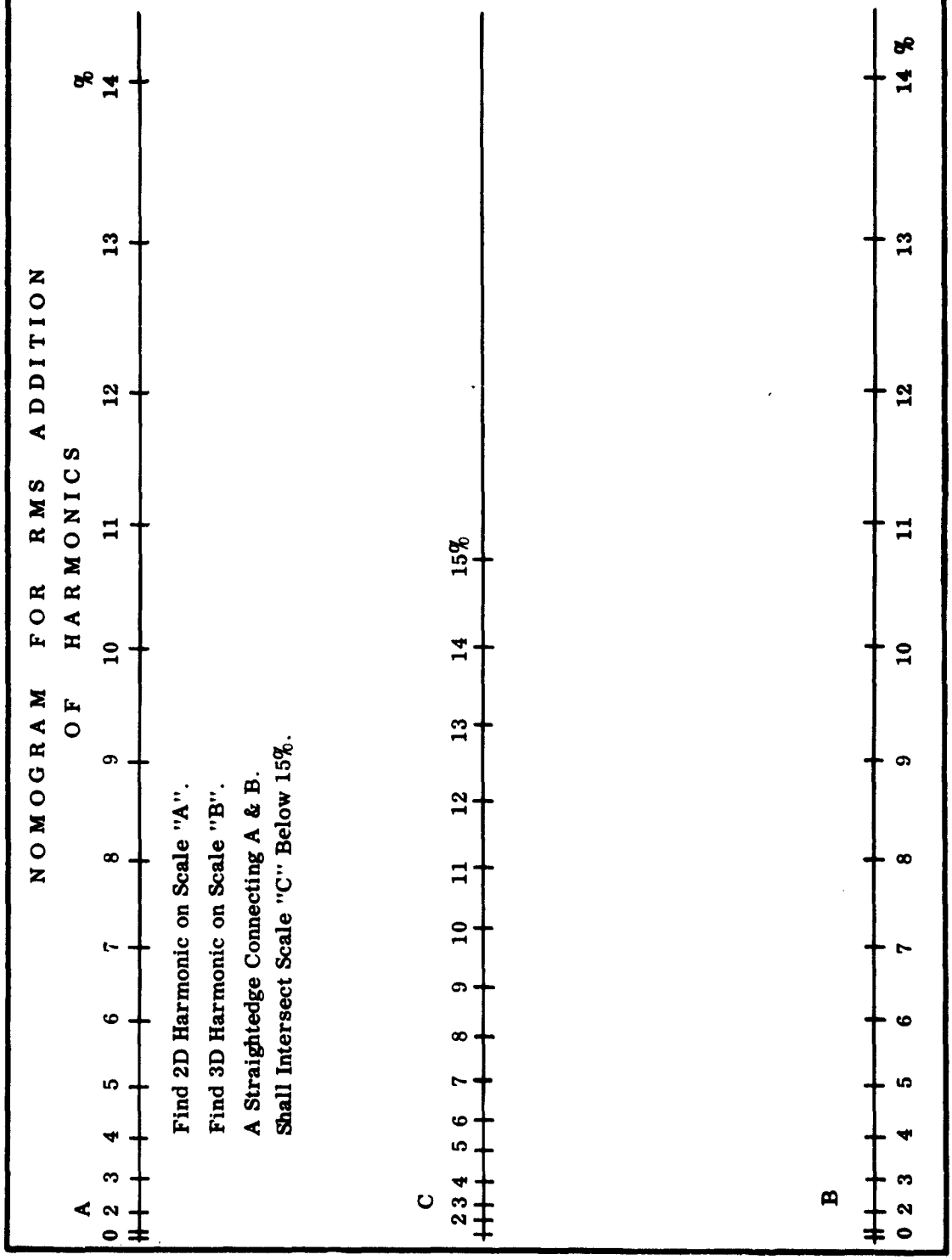
Replay this tape and, using a Sierra Model 158 Wave Analyzer, measure the 2nd and 3rd harmonic amplitudes. Calculate harmonics on chart on page 16. Distortion shall not exceed 15%.

3.4.6 Signal to Noise Ratio
With level adjusted as in 3.2.2, record a section of tape with inputs shorted (carrier only). Replay and measure RMS noise output.

RMS noise level shall be at least 30 db down (-22 dbm or 63 mv on meter) from 2.0 v P-P.

3.4.7 Switching Transients
When reproducing the section of tape as under 3.2.6, examine the noise output with a scope. The switching transients at 1250 μsec intervals should have an amplitude not greater than the P-P noise amplitude.

MODEL FR-700 SYSTEM TEST PROCEDURE TEST SPECIFICATION



MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.4.8 Crosstalk
Record a 50 Kc sine wave at 2v P-P on Channel 1 with Channel 2 input shorted. Then record on Channel 2 with Channel 1 input shorted. Replay this tape and measure the RMS noise and crosstalk output from each channel during the period that its input was shorted. The reading should be 25 db (112 mv) or less.

3.4.9 Timing Accuracy
Record a 1 Kc sine wave. The oscillator should be accurately set for a period of 1 msec. before recording by using a CMC Model 246 Counter.

Replay this section of tape. The reproduced signal should have a period of 997 - 1003 µsec.

If difficulty is experienced in making counter trigger correctly, place SKL filter in line and set to bandpass of 800 to 1200 cps. This filters out extraneous noise.

3.4.10 Linearity
Record a 50 Kc sine wave at input levels of 2v P-P, 1.5 v P-P, 1.0 v P-P, and 0.5 v P-P in sequence.

Replay this tape and measure output levels.

These should be:

Input Level	Output Level
2v	2v (adjusted)
1.5v	1.41 - 1.59v
1.0v	0.94 - 1.06v
0.5v	0.47 - 0.53v

MODEL FR-700
SYSTEM TEST PROCEDURE

TEST SPECIFICATION

3.5.0 Auxiliary Channels

3.5.1 General

The following tests should be conducted at 12.5 ips and 25 ips on both channels.

3.5.2 Levels

Record a 1 Kc sine wave at 1v RMS input level.

Reproduce this signal and adjust R22, Reproduce Gain Controls, for a 1v RMS output level.

3.5.3 Frequency Response

Record the following sine wave frequencies sequentially at an input level of 1.0v RMS; 300 cps, 500 cps, 1 Kc, 3 Kc, 10 Kc, 15 Kc.

Reproduce this recording and measure the output levels. These should all be between 0.70 and 1.41v RMS (±3 db from 1.0 v at 1 Kc) across 600 ohms.

3.5.4 Signal to Noise Ratio

Record a 1 Kc sine wave with a 1v RMS input level. Record again over the same section of tape with the input shorted so as to erase the first recording.

Replay this section of tape and measure the RMS noise output on a VTVM. A SKL 302 filter should be used to limit the bandpass to 250 cps to 16 Kc.

The noise reading obtained should be 30 db (32 mv) or less across 600 ohms.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.5.5 Crosstalk
Record a 1 Kc sine wave at 1v RMS on Channel 1 with Channel 2 input shorted. Then record on Channel 2 with Channel 1 input shorted.

Replay this tape and measure the crosstalk and noise from the sections of tape made with shorted inputs.

The bandwidth should be restricted as under 3.3.4. The reading obtained should be 30 db (32 mv RMS) or less.

3.5.6. Distortion, Total Harmonic
Using Wave Analyzer, Donner 2100, measure 2nd and 3rd harmonic of reproduced 1v RMS, 500 cps signal. Distortion shall not exceed 2% at 25 ips and 3% at 12.5 ips.

3.6.0 Multiplexer

3.6.1 General
The multiplexer is installed on -2 equipment only and converts one Auxiliary Channel into three restricted-range speech channels. The following tests should be conducted in all three speech channels. The standard auxiliary channel should previously have been checked as per 3.3.0.

3.6.2 Levels
Record a 1 Kc sine wave at 1 v RMS input level.

Reproduce this signal. Output should be 1v RMS across 600 ohms. Adjust R10, 15 and 20, if necessary.

MODEL FR-700
SYSTEM TEST PROCEDURE
TEST SPECIFICATION

3.6.3 Frequency Response

Using three HP-200CD oscillators, one at each record input, and each with 150 ohm balanced input impedance, record the following sine wave frequencies sequentially at an input level of 500 mv RMS: 500 cps, 1 Kc, 1.5 Kc, 2.0 Kc, 2.2 Kc.

Replay and measure output levels with a VTVM. These should stay within 50 mv to 1 v. (-20 db to +6 db).

3.6.4 Signal to Noise Ratio

Record with input shorted.

Replay and measure the RMS noise level on a VTVM.

Should be 63 mv or less (18 db below 1 v).

3 6.5 Distortion

Connect the three track reproducer Z-99793 to the three speech channel inputs and play multiplex tape Z-99795. Re-record this tape onto the FR-700.

Replay the FR-700 tape with the Switching Unit Z-99796 and Speaker Amplifier connected. Switch to each channel and listen to this reproduced dialogue.

Should be clearly intelligible.

3.6.6 Crosstalk

Record a 1 Kc sine wave; 1 v RMS input level on channels 1 and 2 with channel 3 input shorted. Repeat with inputs 1 and 2 shorted sequentially.

Replay and measure crosstalk from those sections of the tape for which the inputs were shorted.

APPENDIX B

PRELIMINARY RADIO FREQUENCY INTERFERENCE (RFI) TEST PROCEDURE

Filtron Company, Inc.
System Engineering Division

TEST PROCEDURE

FOR

AMPEX DATA PRODUCTS CO.

OF

RECORDER/REPRODUCER FR-700

AN/GLH4

PROJECT: FLP-7226

FILTRON COMPANY, INC.

PALO ALTO, CALIFORNIA

SYSTEMS ENGINEERING DIVISION

ABSTRACT

The test sample is a wide band magnetic tape recorder that has been developed for the U.S.A.F. by Ampex Data Products Company. This machine is capable of recording wide band signals from 10 cycles to four megacycles on two tracks for one-half hour, or single track for one hour. Two auxiliary tracks are available for recording signals from 20 C.P.S. to 15 KC.

It is proposed that this unit will be submitted to radio frequency interference evaluation testing in accordance with the requirements of Military Specification MIL-I-26600(USAF), Class III, Paragraph 3.5.3.

Upon completion of the radio frequency interference evaluation test, a comprehensive test report, prepared in compliance with the requirements of paragraph 4.1 of Military Specification MIL-I-26600(USAF), will be issued. This report will include both tabulated and graphical data indicating the degree of compliance with the applicable interference control document.

1.0 SCOPE:

1.1 It is the intent of the enclosed procedure to provide test data indicating the degree of compliance of the FR-700 Recorder/ Reproducer, AN/GLH-4, to Military Specification MIL-I-26600(USAF), dated 2 June 1958, and entitled "Interference Control Requirements, Aeronautical Equipment".

2.0 TEST EQUIPMENT:

2.1 NF-105 Field Intensity Meter, frequency range .15 - 1000 mc.
2.2 Filtron FSR 703N Line Impedance Stabilization Networks (5 each).
2.3 Bird 6-position Coaxial Switch.
2.4 12' x 24' x 8' Double Shielded Enclosure complying with Military Specification MIL-E-4957A.
2.5 General Radio Signal Generator, Model 805B, or equivalent, frequency range .16 - 50 mc.
2.6 General Radio Signal Generator, Model 1021-P1, or equivalent, frequency range 50 - 250 mc.
2.7 General Radio Signal Generator, Model 1021-P3B, or equivalent, frequency range 250 - 920 mc.
2.8 Audio Generator, Hewlett-Packard 200 CD, or equivalent.

3.0 TEST PROCEDURE:

3.1 Conducted interference, .15 - 25 mc.

3.1.1 Place AN/GLH-4 in shielded enclosure, as shown in Figure I and as prescribed in paragraph 4.3.1 and 4.3.1.1 of Military Specification MIL-I-26600(USAF).

3.1.2 Connect FSR 703N Line Impedance Stabilization Networks in series with each ungrounded power lead of AN/GLH-4, as shown in Figure I and in accordance with paragraph 4.3.1.1 of Military Specification MIL-I-26600(USAF).

3.1.3 Connect external cables and loads, as shown in Figure I.

3.1.4 Connect NF-105 to DC power lead through line impedance stabilization network, as shown in Figure I. Apply power.

3.1.5 Monitoring the power leads, slowly scan the frequency range of .150 - 25 mc and record all voltage peaks (not less than three (3) frequencies per octave). Record voltage peaks in terms of CW (narrow band), or broadband interference, or both, as described in paragraphs 4.1.7 and 4.1.8 of Specification MIL-I-26600(USAF).

3.2 Radiated Measurements, .15 - 25 mc.

3.2.1 Set up MF-105 with 41" rod antenna positioned as shown in Figure I and as required in paragraphs 4.2.6 and 4.2.7 of Specification MIL-I-26600(USAF).

3.2.2 Slowly scan the frequency range of .15 - 25 mc and record all peak voltage levels (not less than three (3) per octave). Record voltage peaks in terms of either CW (narrow band), or broadband interference, whichever is applicable, as required in paragraphs 4.1.7 and 4.1.8 of Specification MIL-I-26600(USAF).

3.3 Radiated Measurements, 25 - 1000 mc.

3.3.1 Set up resonant dipole antenna and position, as shown in Figure I and as required in paragraphs 4.2.6 and 4.2.7 of Specification MIL-I-26600(USAF).

3.3.2 Slowly scan the frequency range of 25 - 1000 mc and record all peak voltage levels (not less than three (3) per octave). Record voltage peaks in terms of CW (narrow band), or broadband interference, or both, whichever is applicable, as required in paragraphs 4.1.7 and 4.1.8 of Specification MIL-I-26600(USAF).

3.4 Conducted R.F. Susceptibility.

3.4.1 Connect output of signal generator to center of coaxial switch and slowly scan frequency range. Repeat for each setting of coaxial switch, changing generators as required. Setup will be as shown in Figure I with generators substituted for MF-105.

3.5 Radiated R. F. Susceptibility, .15 - 25 mc.

3.5.1 Connect signal generator output to 41" rod antenna and slowly scan frequency range.

3.6 Radiated R.F. Susceptibility, 25 - 1000 mc.

3.6.1 (25 - 35 mc) Using a 35 mc dipole antenna, as shown in Figure I, but with signal generator in place of MF-105, slowly scan frequency range.

3.6.2 (35 - 1000 mc) With same setup as explained in 3.6.1 and shown in Figure I, but using tuned dipole antenna, slowly scan frequency range.

4.0 MONITORING:

4.1 Wide band Channels 1 and 2 and auxiliary channels 1 and 2 will be terminated at the end of five foot long coaxial leads with 100 ohm resistors. Monitoring will be accomplished on one of each of the above channels during playback by visual observation of a V.T.V.M. The monitor output will be terminated with a 28 volt lamp which will also be monitored visually during playback.

4.2 Monitoring for malfunction during record will be accomplished by continuously recording during application of external fields and voltages. The tape thus recorded will later be checked for signal to noise ratio.

4.3 Acceptance limits for monitoring devices are to be established by Ampex engineers.

5.0 GENERAL COMMENTS:

5.1 Signal inputs: During operation a continuous sine wave signal of 4 mc and 1.6 volt peak to peak will be applied to Channel 1 and 2.

5.1.1 Sine wave signal of 1.6 volt peak to peak at 10 KC will be applied to one of the auxiliary channels; the other two channels will have no signal applied during test.

5.2 Switching transients encountered in the normal operation of the equipment are exempted from measurement under paragraph 3.1.2 of Specification MIL-I-26600(USAF) and will not be measured.

6.0 TEST REPORT:

6.1 A comprehensive test report in accordance with the applicable paragraphs of Specification MIL-T-9107 will be issued at the completion of this test.

Peter F. Spencer
Zone Manager

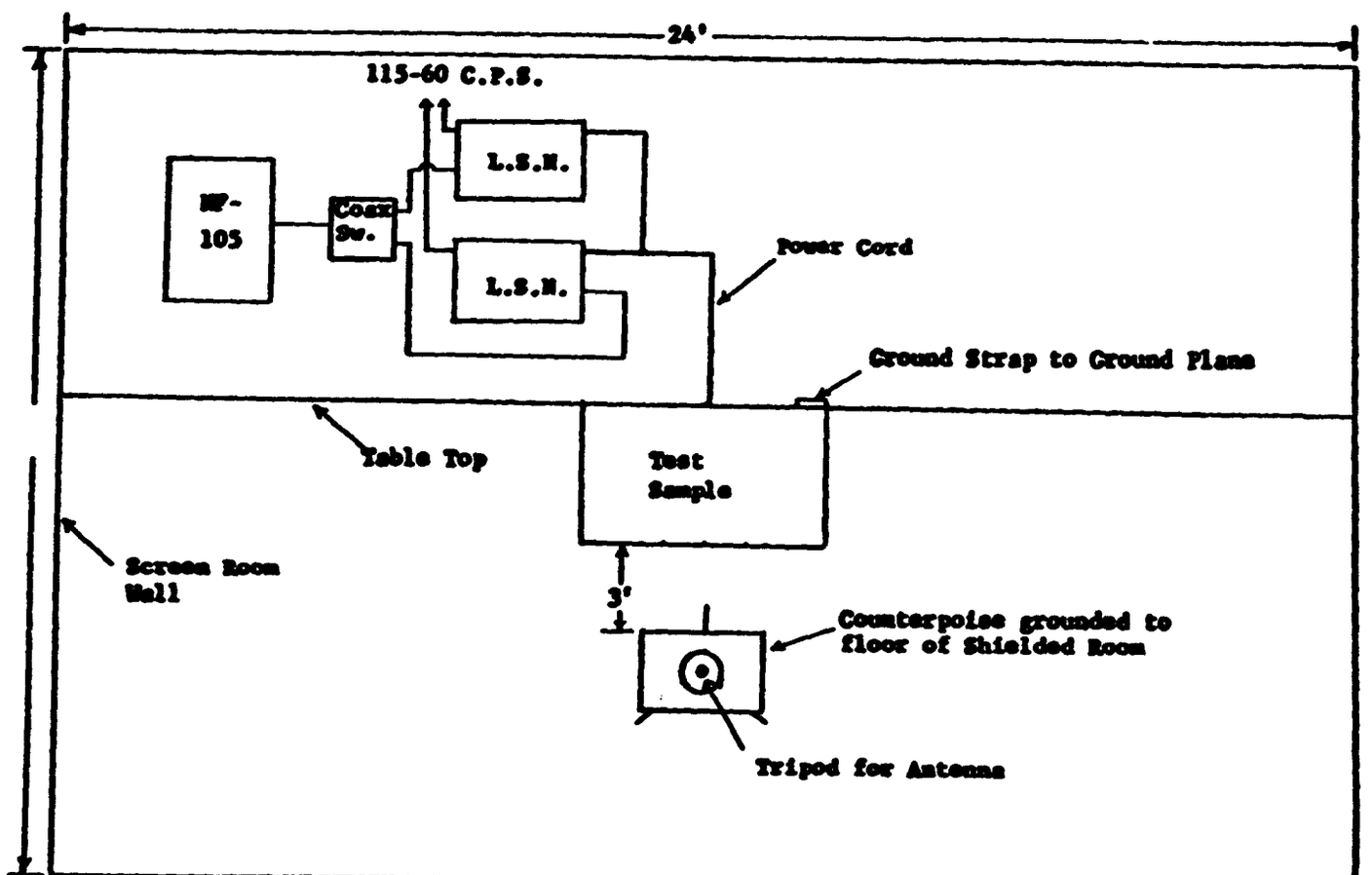

24'
115-60 C.P.S.
L.S.N.
MF-
105
Coax
Sw.
L.S.N.
Power Cord
Ground Strap to Ground Plane
Table Top
Test
Sample
Screen Room
Wall
3'
Counterpoise grounded to
floor of Shielded Room
Tripod for Antenna

FIGURE I.

APPENDIX C

DATA SHEET

PRELIMINARY ACCEPTANCE TEST,

AN/GLH-4

AMPEX INSTRUMENTATION PRODUCTS COMPANY

REDWOOD CITY, CALIFORNIA

Test Data

Preliminary Acceptance Test.

Model AN/GLH-4 (XW-2) Recorder-Reproducer Set, Signal Data

Date 10 MAY 1961

CPD or SO 527591

Equipment Serial 101

Transport Serial 101

Wideband Head Serial 228

Auxiliary Head Serial 101

Tape type MYLAR

Test equipment calibration up-to-date: Yes ✓ No ____

Checked by: _____ Dept. _____

D Johnson 749 (QC)

W L Smith 431

Tell Barger 431

App'd by Surveillance _____ Date 17 MAY 1961

Wideband head hours 39

Purpose: This data sheet shall be used to record the performance of the required tests and measurements. All tabulated data shall show the exact measurement value regardless of the end result. Where no data is applicable answer yes, no or make suitable remarks.

REMARKS 1. ALL READINGS THAT ARE NOTED BY AN ASTERISK DO NOT CONFORM TO TEST SPECIFICATIONS AS PER Q.C. SP 48000.

DEVIATIONS FOR THE ABOVE WILL BE AUTHORIZED BY T BARGER.

D Johnson Q.C. F.S.T.

Reference: The following paragraph numbers correspond to the paragraph numbers in ST-48000 C, Preliminary Acceptance Test Specification, AN/GLH-4 (XW-1)

4.1 Mechanical Inspection Tests

4.1.1 Visual

4.1.1.1 Quality of workmanship OK

4.1.1.2 Identification Marking per MIL-STD-130 OK

4.1.1.3 Color per FED-STD-595 #36176 OK

4.2 Electrical Inspection Tests

4.2.1 Required Electrical Tests

4.2.1.1 Power Distribution

(1) Power

(1.1) Frequency Changer

Output A: 29.0 VDC

Ripple 70.0 MVRMS

Output B:

Line to ground

Phase A 119 VRMS

B 119 VRMS

C 119 VRMS

(1.2) Power Supplies

Output C: 27.92 VDC

Output D: 23.85 VDC

Ripple 30. MV

Output F: See Note 1 VDC

Ripple MV

Output E: 23.37 VDC

Output G: ~~24.02~~ VDC

Ripple * ~~60~~ MV

5/17/61
TWB

SUPPLY REPLACED
23.9 VDC
30 MV

REMARKS:

1. OUTPUT F IS A REPEAT OF D.

4.2.1.2 Control and Indication functions

4.2.1.2.1.1 Control functions and Interlock. OK

4.2.1.2.1.2 Tape Pack Sensor. OK

4.2.1.2.2 Control, Remote Station

4.2.1.2.2.1 Control functions and mode interlock OK

4.2.1.2.2.2 T ape Pack Sensor OK

4.2.1.2.2.3 Control Status Interlock OK

4.2.1.2.3 Control Indication OK

4.2.1.2.4 Remote Indication of Anticipation of End of Tape

- 12.5 ips 50 sec
- 25 ips 51 sec

4.2.1.2 5 Remote Indication of End of Tape OK

4.2.1.2.6 Record Confidence Monitor OK

4.2.2 Optional Electrical Inspection Tests

4.2.2.1 Inherent Soundness of Circuitry

(1) Wide Band Record

(1.1) Modulator

(a) Dash 1 H.F. Osc. frequency 87 Mc
(b) Dash 2 L.F. Osc. frequency 100 Mc
(c) Carrier frequency
Channel 1 6 Mc
Channel 2 6 Mc

(1.2) Carrier level
(a) Channel 1 head 1 & 3 65 Vpp
(b) Channel 1 head 2 & 4 65 Vpp
(c) Channel 2 65 Vpp

REMARKS

(1.3) Timing Pulse Position

(1.3.1) Pulse Slope

(a) Rise Time .18 μ SEC

(b) Fall Time .18 μ SEC

(c) Width (50% Amplitude) 1.8 μ SEC

(1.3.2) Pulse Position

(a) Head 2; beginning of carrier to timing pulse 80 μ sec.

(b) Head 1; end of carrier to timing pulse 80 μ sec.

(1.4) Control Track Record:

(a) Wave form conforms to specification requirements Yes

(b) Amplitude 1.0 V p-p

(2) WideBand Reproduce

(2.1) Female Guide Servo Yes

(2.2) AM Pulse Detector timing pulses Yes

(2.3) Switcher AFC Yes

(2.4) Switcher Gated Amplifier 1V Vpp

(2.5) Tracking Phase Control Yes

(2.6) Control Track Reproduce

(a) TP-1 2 Vpp

(b) TP-2 30 Vpp

(2.7) Head Drum Servo

(a) Wave from symmetry 100 %

(b) Jetter 20 μsec p-p

(2.8) Capstan Servo

(a) Wave form conforms to specification requirments Yes

(b) Wave Movement Slight

REMARKS:

(3) Auxiliaries Record

(3.1) Record current .7 ma RMS

(3.2) Bias

(a) Current 12 ma RMS
(b) Frequency 105 Kc
(c) Distortion ____ % CH #1 - 2%
CH #2 - 2.8%

(3.3) Erase

(a) Current 116 ma

4.2.2.2 Radio Frequency Interference _____

4.3 Performance Tests

4.3.1 Required Performance Tests

4.3.1.1 Mechanical Performance Tests

4.3.1.1.1 Tape Speed

4.3.1.1.1.1 Record and Reproduce

(a) @ 12.5 ips 10.02 sec
2.0 %

(b) @ 25. ips 10.02 sec
2.0 %

4.3.1.1.12 Fast Forward and Rewind

(a) Fast forward 3.95 min
(b) Rewind 3.95 min

4.3.1.1.2 Start Time

4.3.1.1.2.1 Start Time Record Mode

(a) Head drum trace 3.9 sec

(b) Capstan trace 3.9 sec

REMARKS:

4.3.1.1.2.2 Start Time Reproduce Mode 3.8 sec

4.3.1.1.3 Stop Time

4.3.1.1.3.1 Stop Time Record and Reproduce

(a) Record

1. @ 12.5 ips .5 sec
2. @ 25 ips .5 sec

(b) R eproduce

1. @ 12.5 ips .5 sec
2. @ 25 ips .5 sec

4.3.1.1.3.2 Stop Time Fast Forward and Rewind

(a) Fast Forward .75 sec

(b) Rewind .80 sec.

4.3.1.1.4 Tape packing slip 0 in.

4.3.1.1.5 Automatic Stop Yes

4.3.1.2 Electrical Performance Tests

4.3.1.2.1 Wide Band Signal Channels

4.3.1.2.1.1 Output Level

(a) Reference level	-3	db m
(b) J-175	-3	db m
(c) J-179	-3	db m
(d) J-257		db
(e) J-259		DB

4.3.1.2.1.2 Signal-to-noise Ratio

(a) Reference level channel 1	-3	db
(b) Reference level channel 2	-3	db
(c) Noise level channel 1	-28	db
(d) Noise level channel 2	-31	db
(e) S/N Ratio channel 1	-34	db
(f) S/N Ratio Channel 2	-37	db

REMARKS:

4.3.1.2.1.3 Frequency Response

(a) Channel 1 Reference level -3 db m

(b) Channel 2 Reference level -3 db m

(c) Response level

Frequency	Channel 1			Channel 2	
	25 IPS	12.5 IPS		25 IPS	
10c	-6	-5 1/2	dbm	-5 1/2	dbm
50c	-3	-3	db	-2 1/2	db
100c	-3	-3	db	-2 1/2	db
500c	-2 1/2	-3	db	-2 1/2	db
5 kc	-2 1/2	-3	db	-2 1/2	db
10 kc	-2 1/2	-3	db	- 2 1/2	db
50 kc	-3	-3	db	-3	db
100 kc	-2 1/2	-2 1/2	db	-2 1/2	db
1 mc	-3	-3	db	-1 1/2	db
2 mc	-3	-3	db	-1 1/2	db
2.5mc	-5	-5	db	-2 1/2	db
3 mc	-7	-6 1/2	db	-7	db
4 mc	-13	-13	db	-13	db

(d) Frequency Response Scope Pictures

1. 50 k.c. attached
2. 1 mc "
3. 2 mc "
4. 3 mc "
5. 4 mc "

4.3.1.2.1.4 Pulse Response

		Channel 1	Channel 2
(a)	Rise Time	usec	usec
(b)	Delay Time	usec	usec
(c)	Overshoot	%	%
(d)	Droop	%	%
(e)	Output voltage	up	up
(f)	Undershoot	%	%

(g) Pulse Response Pictures

1. Channel 1 1 u sec pulse 0 to .8 volts peak positive going
2. Channel 2 " " "
3. Channel 1 " " negative going
4. Channel " " "

REMARKS:

Pictures attached for information required in 4.3.1.2.1.4

4.3.1.2.1.5 Fidelity of Reproduced Signal

	25 IPS Channel 1	25 IPS Channel 2	12 IPS Channel 1
2nd Harmonic Amplitude	.05	.07	.05
3 rd " "	.0032	.005	.0032
Distortion	13.5 %	10.5 %	13.5 %

4.3.1.2.1.6 Switching Transient

4.3.1.2.1.6.1 Amplitude .6 v p.p

4.3.1.2.1.6.2 Clamp Period .4 u sec

4.3.1.2.1.7 Crosstalk

(a) Channel 1 signal level -3 db
(b) Channel 2 crosstalk level -26 db
(c) Channel 2 crosstalk -32 db
(d) Channel 2 signal level -3 db
(e) Channel 1 crosstalk level -24 db
(f) Channel 1 crosstalk -30 db

4.3.1.2.1.8 Dynamic Linearity

(a) Channel 1

Input level		Output level
2 v p-p	Ref (adj)	2.0 Vpp
1.6 v p-p		1.6 vpp
1.0 v p-p		1.1 vpp
0.5 v p-p		.49 vpp

(b) Channel 2

Input level		Output level
2 v p-p	Ref (adj)	1.95 vpp
1.6 vpp		1.6 vpp
1.0 vpp		1.0 vpp
0.5 vpp		.52 vpp

4.3.1.2.1.9 Timing Accuracy

(a) @ 12.5 ips ± 2 μ sec
(b) @ 25 ips ± 2 μ sec

4.3.1.2.2 Auxiliary Signal Channel

4.3.1.2.2.1 Output level

(a) Channel 1 1.0 vRMS
(b) Channel 2 1.0 vRMS

REMARKS:

4.3.1.2.2.2 Frequency Response

	25 IPS	12.5 IPS	
(a) Channel 1 Reference level	-2	-2	db
(b) Channel 2 Reference level	-2	-2	db

(c) Response level

Frequency	Channel 1 25 IPS	Channel 1 12.5 IPS		Channel 2 25 IPS	Channel 2 12.5 IPS	
300 c	-1	0	db	- 1/2	- 1/2	db
500 c	+2	+2	db	+2	+2	db
1 kc	+3 1/2	+3	db	+4 1/2	+3	db
10 kc	+4	+3	db	+4 1/2	+3	db
15 kc	+3 1/2	0	db	+3 1/2	-1	db
3 kc	+4	+2 1/2	db	+5	+2	db

4.3.1.2.2.3 Signal-to-Noise Ratio

	25 IPS	12.5 IPS	
(a) Reference level Channel 1	+2	+2	db
(b) Reference level channel 2	+2	+2	db
(c) Noise level channel 1	-28	-29	db
(d) " " " 2	-32	-32	db
(e) S/N Ratio " 1	-30	-31	db
(f) " " 2	-34	-34	db

4.3.1.2.2.4 Crosstalk

	25 IPS	12.5 IPS	
(a) Channel 1 signal level	+2	+2	db
(b) " 2 cross talk level	-32	-30	db
(c) " 2 cross talk	-34	-32	db
(d) " 2 signal level	+2	+2	db
(e) " 1 cross talk level	-28	-28	db
(f) " 1 cross talk	-30	-30	db

4.3.1.2.2.5 Distortion at 1000 cycles

	Channel 1 25 IPS	Channel 1 12.5 IPS	Channel 2 25 IPS	Channel 2 12.5 IPS
2nd Harmonic Distortion Amplitude	3.4%	3.8%	3%	3%
3rd " " "	.8%	2.8%	0.3%	1.3%
Distortion	3.5%	4.7 %	3.1%	3.3 %

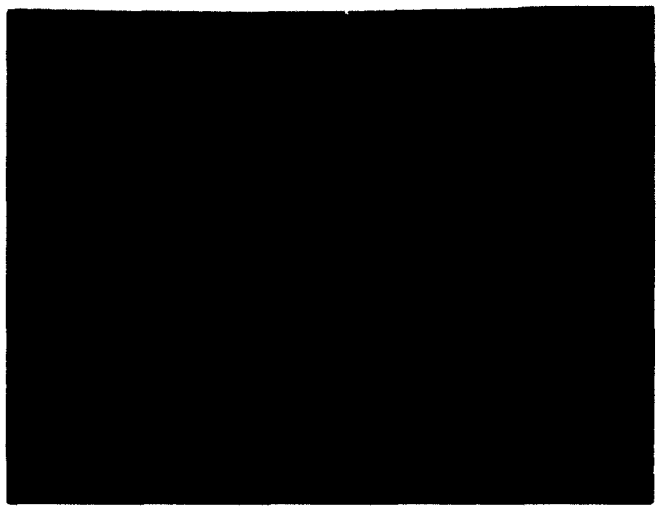
4.3.1.2.2.6 Flutter

(a) @ 12.5 ips	.30	%
(b) @ 25 ips	.30	%

REMARKS:

4.3.1.2.1.3(d) (Continued)

Frequency response Pictures AN/GLH-4 SER 101 Head Ser. 228

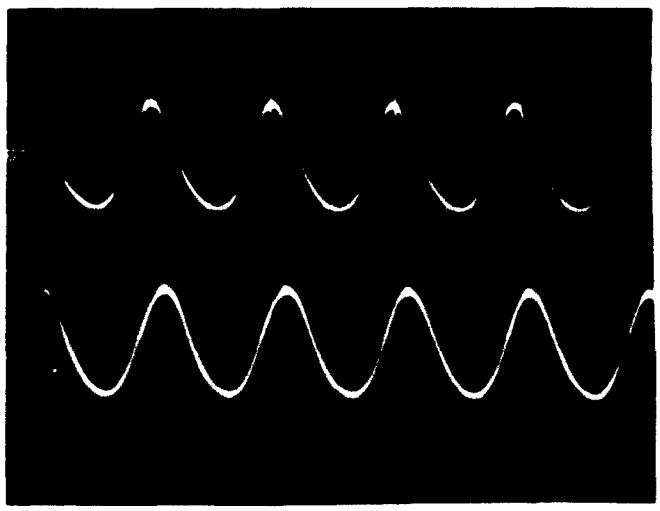


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. I 50 KCS

Scale: Vertical: 1.0v/DIV
Horisontal: 10 μ sec/DIV

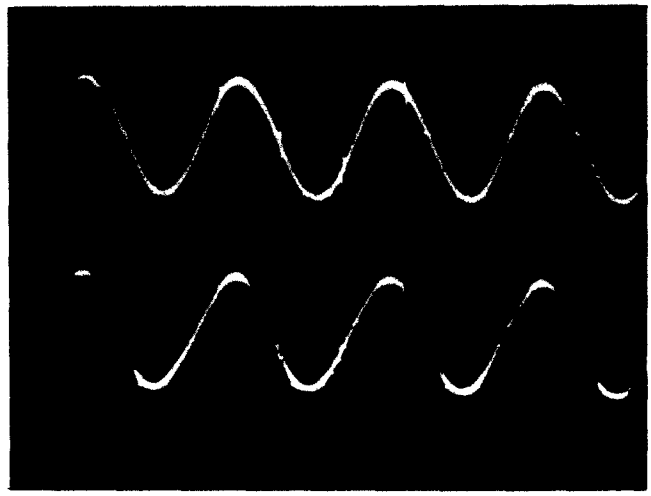


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 2 1 MCS

Scale: Vertical: 1.0 v/DIV
Horisontal: 0.5 μ sec/DIV

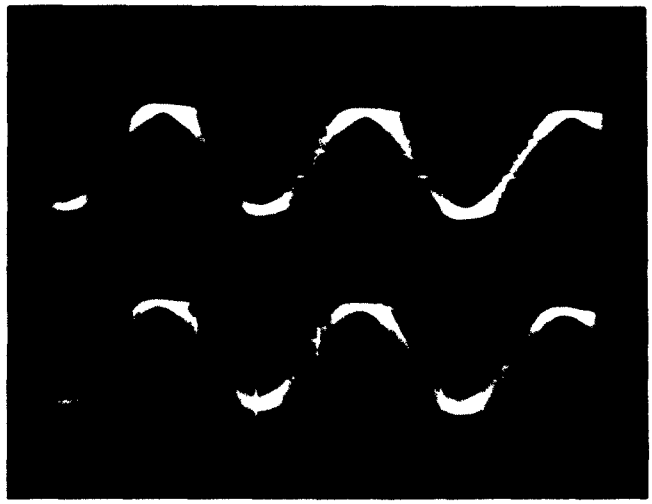


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 3 2 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.2 μ sec/DIV



CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 4 3 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.1 μ sec/DIV

CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

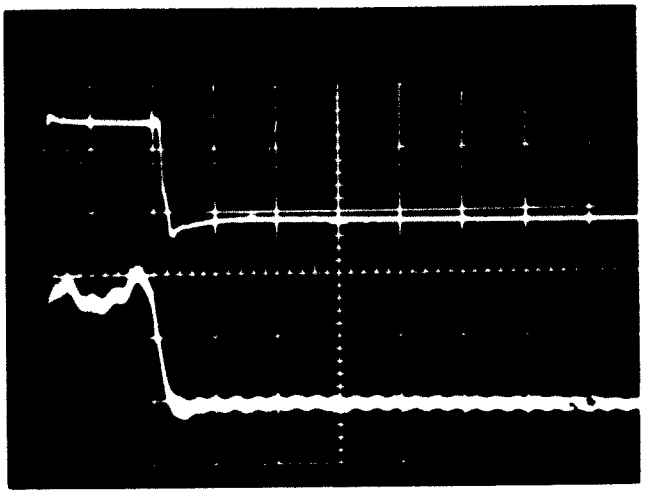
Fig. 5 4 MCS

Scale: Vertical: 0.5 v/DIV
Horizontal: 0.1 u sec/DIV

4.3.1.2.1.4 (g) (Continued)

Pulse Response Pictures AN/GLH-4 Serial 101 Head Serial 228

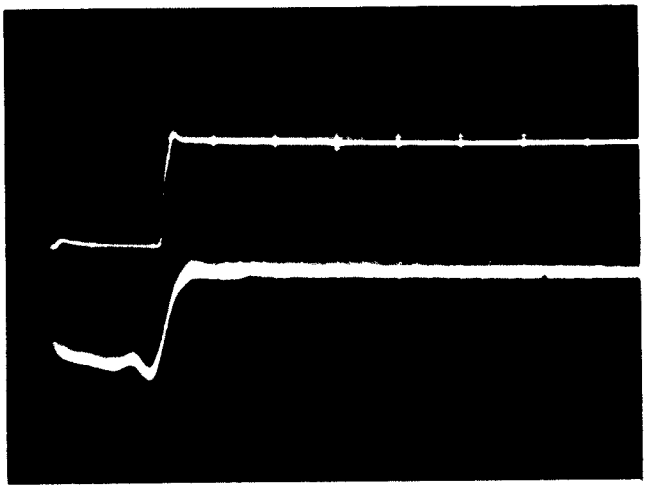
Scale (all pictures): Horizontal: 0.5 u sec/DIV
Vertical 0.5 V/DIV



INPUT PULSE

CHANNEL 1
Reproduce

Fig. 1 1 μsec positive going pulse



INPUT PULSE

CHANNEL I
Reproduce

Fig. 2 1 μsec negative going pulse

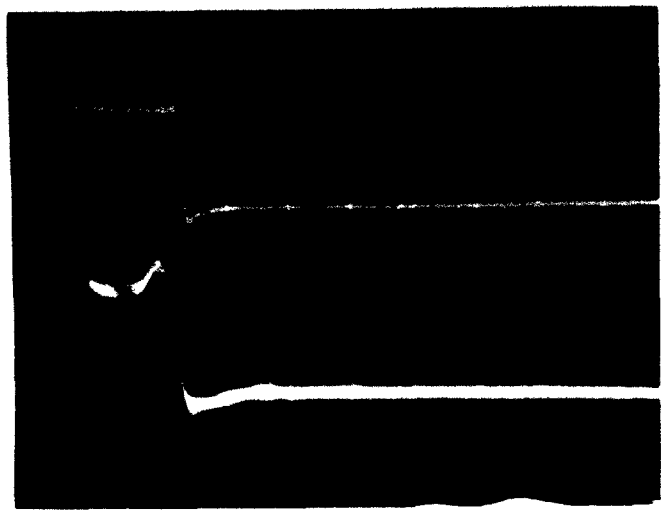


Fig. 3 1 μsec positive going pulse

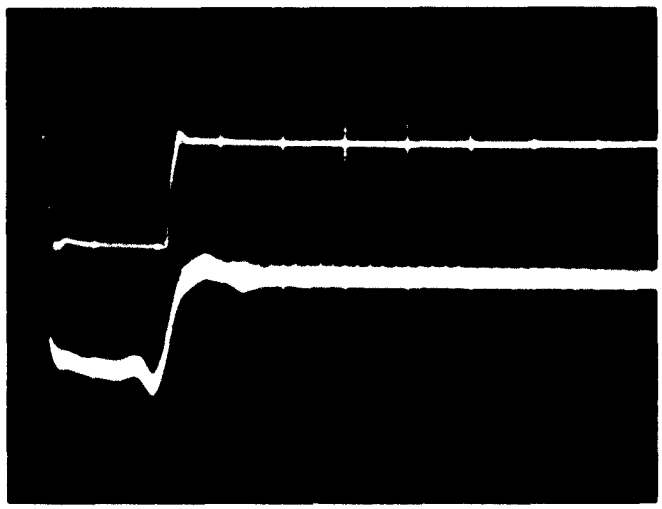


Fig. 4 1 μsec negative going pulse

AMPEX INSTRUMENTATION PRODUCTS COMPANY

REDWOOD CITY, CALIFORNIA

Test Data

Preliminary Acceptance Test

Model AN/GLH-4 (XW-1) Recorder-Reproducer Set, Signal Data

Date 6-19-61

CPD or SO 527591

Equipment Serial _____

Transport Serial 102

Wideband Head Serial 249

Auxiliary Head Serial 102

Tape Type 1 MIL MYLAR

Test equipment Calibration up-to-date: Yes _____ No _____

Checked By: [signature] Dept. 749

[signature] 749

[signature] 749

[signature] 931

App'd By [signature] Date 21 June 61

Surveillance:

WideBand head hours 45

Purpose: This data sheet shall be used to record the performance of the required tests and measurements. All tabulated data shall show the exact measurement value regardless of the end result. Where no data is applicable answer yes, no or make suitable remarks.

REMARKS

Reference: The following paragraph numbers correspond to the paragraph numbers in ST-48000 C, Preliminary Acceptance Test Specification, AN/GLH-4 (XW-1)

4.1 Mechanical Inspection Tests OK

4.1.1 Visual OK

4.1.1.1 Quality of workmanship OK

4.1.1.2 Identification Marking per MIL-STD-130 OK

4.1.1.3 Color per FED-STD-595 #36176 OK

4.2 Electrical Inspection Tests

4.2.1 Required Electrical Tests

4.2.1.1 Power Distribution

(1) Power

(1.1) Frequency Changer

Output A: 29-1/2 VDC

Ripple 60 MVRMS

Output B:

Line to ground

Phase A 113 VRMS

B 112 VRMS

C 112 VRMS

(1.2) Power Supplies

Output C: 27.0 VDC

Output D: 23.9 VDC

Ripple 60 MV p-p

Output F: See Note # 1 VDC

Ripple MV

Output E: 23.5 VDC

Output G: 24.1 VDC

Ripple 60 MV p-p

REMARKS:

#1. OUTPUT F IS A REPEAT OF D

4.2.1.2 Control and Indication functions

4.2.1.2.1.1 Control functions and Interlock. OK

4.2.1.2.1.2 Tape Pack Sensor. Not Installed

4.2.1.2.2 Control, Remote Station

4.2.1.2.2.1 Control functions and mode interlock OK

4.2.1.2.2.2 T ape Pack Sensor Not Installed

4.2.1.2.2.3 Control Status Interlock OK

4.2.1.2.3 Control Indication OK

4.2.1.2.4 Remote Indication of Anticipation of End of Tape

- 12.5 ips Not Installed sec
- 25 ips " " sec

4.2.1.2 5 Remote Indication of End of Tape Not Installed

4.2.1.2.6 Record Confidence Monitor OK

4.2.2 Optional Electrical Inspection Tests

4.2.2.1 Inherent Soundness of Circuitry

(1) Wide Band Record

(1.1) Modulator

(a) Dash 1 H.F. Osc. frequency 87 Mc
(b) Dash 2 L.F. Osc. frequency 106 Mc
(c) Carrier frequency
Channel 1 6 Mc
Channel 2 6 Mc

(1.2) Carrier level
(a) Channel 1 head 1 & 3 70 Vpp
(b) Channel 1 head 2 & 4 70 Vpp
(c) Channel 2 70 Vpp

REMARKS

(1.3) Timing Pulse Position

(1.3.1) Pulse Slope

(a) Rise Time 0.15 μ SEC

(b) Fall Time 0.20 μ SEC

(c) Width (50% Amplitude) 1.8 μ SEC

(1.3.2) Pulse Position

(a) Head 2; beginning of carrier to timing pulse 80 μ sec.

(b) Head 1; end of carrier to timing pulse 65 μ sec.

(1.4) Control Track Record:

(a) Wave form conforms to specification requirements Yes

(b) Amplitude 0.6 V p-p

(2) WideBand Reproduce

(2.1) Female Guide Servo OK

(2.2) AM Pulse Detector timing pulses OK

(2.3) Switcher AFC OK

(2.4) Switcher Gated Amplifier 1.0 Vpp

(2.5) Tracking Phase Control Yes

(2.6) Control Track Reproduce

(a) TP-1 3.2 Vpp

(b) TP-2 3.2 Vpp

(2.7) Head Drum Servo

(a) Wave from synnetry 3.0 %

(b) Jetter 20 μsec p-p

(2.8) Capstan Servo

(a) Wave form conforms to specification requirments Yes

(b) Wave Movement None

REMARKS:

(3) Auxiliaries Record

(3.1) Record current 0.7 ma RMS

(3.2) Bias

(a) Current 12.5 ma RMS
(b) Frequency 103.2 Kc
(c) Distortion 4.4 % CHANNEL 1*
5.6 % CHANNEL 2*

(3.3) Erase

(a) Current 110 ma

4.2.2.2 Radio Frequency Interference Separate Report

4.3 Performance Tests

4.3.1 Required Performance Tests

4.3.1.1 Mechanical Performance Tests

4.3.1.1.1 Tape Speed

4.3.1.1.1.1 Record and Reproduce

(a) @ 12.5 ips 10.02 sec
0.2% slow %

(b) @ 25. ips 10.02 sec
0.2% slow %

4.3.1.1.12 Fast Forward and Rewind

(a) Fast forward 4.0 min
(b) Rewind 4 min 10 sec min

4.3.1.1.2 Start Time

4.3.1.1.2.1 Start Time Record Mode

(a) Head drum trace 4 sec

(b) Capstan trace 2.5 sec

REMARKS:

4.3.1.1.2.2 Start Time Reproduce Mode 4.5 sec

4.3.1.1.3 Stop Time

4.3.1.1.3.1 Stop Time Record and Reproduce

(a) Record

1. @ 12.5 ips 0.25 sec

2. @ 25 ips 0.25 sec

(b) R eproduce

1. @ 12.5 ips 0.25 sec

2. @ 25 ips 0.25 sec

4.3.1.1.3.2 Stop Time Fast Forward and Rewind

(a) Fast Forward 0.75 sec

(b) Rewind 1.0 sec.

4.3.1.1.4 Tape packing slip None in.

4.3.1.1.5 Automatic Stop Yes

4.3.1.2 Electrical Performance Tests

4.3.1.2.1 Wide Band Signal Channels

4.3.1.2.1.1 Output Level

(a) Reference level	-3	dbm
(b) J-175	-3	dbm
(c) J-179	-3	dbm
(d) J-257	-3	dbm
(e) J-259	-3	DBM

4.3.1.2.1.2 Signal-to-noise Ratio

(a) Reference level channel 1	-3	db
(b) Reference level channel 2	-3	db
(c) Noise level channel 1	-28.5	db
(d) Noise level channel 2	-28.0	db
(e) S/N Ratio channel 1	-34.5	db
(f) S/N Ratio Channel 2	-34.0	db

REMARKS:

4.3.1.2.1.3 Frequency Response

(a) Channel 1 Reference level -3 db

(b) Channel 2 Reference level -3 db

(c) Response level

Frequency	Channel 1	Channel 2
10c	-4 db m	-4 db m
50c	-2 db m	-2.5 db m
100c	-2 db m	-2.5 db m
500c	-2 db m	-2.5 db m
5 kc	-2.5 db m	-2.5 db m
10 kc	-2.5 db m	-2.5 db m
50 kc	-3 db m	-3 db m
100 kc	-2.5 db m	-2.5 db m
1 mc	-3 db m	-2.25 db m
2 mc	-1.5 db m	-3 db m
2.5mc	-2.75 db m	-2.75 db m
3 mc	-6 dbm	-4 db m
4 mc	-11 db m	-8 db m

(d) Frequency Response Scope Pictures

1. 50 k.c. Attached
2. 1 mc "
3. 2 mc "
4. 3 mc "
5. 4 mc "

4.3.1.2.1.4 Pulse Response

	Channel 1	Channel 2
(a) Rise Time	0.14 usec	0.14 usec
(b) Delay Time	0.14 usec	0.14 usec
(c) Overshoot	%	%
(d) Droop	%	%
(e) Output voltage	up	up
(f) Undershoot	%	%

(g) Pulse Response Pictures

1. Channel 1 1 u sec pulse 0 to .8 volts peak positive going
2. Channel 2 " " "
3. Channel 1 " " negative going
4. Channel " " "

REMARKS:

Pictures attached for Para 4.3.1.2.1.4

4.3.1.2.1.5 Fidelity of Reproduced Signal

	Channel 1	Channel 2
2nd Harmonic Amplitude	.01	.01
3 rd " "	.004	.003
Distortion	2.1 %	1.8 %

4.3.1.2.1.6 Switching Transient

4.3.1.2.1.6.1 Amplitude .6 v p.p

4.3.1.2.1.6.2 Clamp Period 14 u sec Reading is 0.4 μsec 8/15/61 TWB

4.3.1.2.1.7 Crosstalk

(a) Channel 1 signal level -3 dbm
(b) Channel 2 crosstalk level -29 db m
(c) Channel 2 crosstalk -32 dbm
(d) Channel 2 signal level -3 dbm
(e) Channel 1 crosstalk level -28 dbm
(f) Channel 1 crosstalk -31 db m

4.3.1.2.1.8 Dynamic Linearity

(a) Channel 1

Input level		Output level
2 v p-p		2.0 Vpp
1.6 v p-p	Ref (adj)	1.6 vpp
1.0 v p-p		.98 vpp
0.5 v p-p		.5 vpp

(b) Channel 2

Input level		Output level
2 v p-p		1.9 vpp
1.6 vpp	Ref (adj)	1.6 vpp
1.0 vpp		1.0 vpp
0.5 vpp		.49 vpp

4.3.1.2.1.9 Timing Accuracy

(a) @ 12.5 ips -1 μ sec
(b) @ 25 ips -1 μ sec

4.3.1.2.2 Auxiliary Signal Channel

4.3.1.2.2.1 Output level

(a) Channel 1 1.0 vRMS
(b) Channel 2 1.0 vRMS

REMARKS:

4.3.1.2.2.2 Frequency Response

(a) Channel 1 Reference level +2 db

(b) Channel 2 Reference level +2 db

(c) Response level

Frequency	Channel 1	Channel 2
300 c	-1 db	-1 db
500 c	+1 db	+1 db
1 kc	+2 db	+2 db
10 kc	+4 db	+2 db
15 kc	+4 db	+1 1/2 db

4.3.1.2.2.3 Signal-to-Noise Ratio

(a) Reference level Channel 1 +2 db

(b) Reference level channel 2 +2 db

(c) Noise level channel 1 -32 db

(d) " " " 2 -37 db

(e) S/N Ratio " 1 -34 db

(f) " " 2 -39 db

4.3.1.2.2.4 Crosstalk

(a) Channel 1 signal level +2 db

(b) " 2 cross talk level -34 db

(c) " 2 cross talk -36 db

(d) " 2 signal level +2 db

(e) " 1 cross talk level -32 db

(f) " 1 cross talk -34 db

4.3.1.2.2.5 Distortion

	Channel 1	Channel 2
2nd Harmonic Distortion Amplitude	-32	-25
3rd " " "	-36	-32
Distortion	1.4 %	3.0 %

4.3.1.2.2.6 Flutter

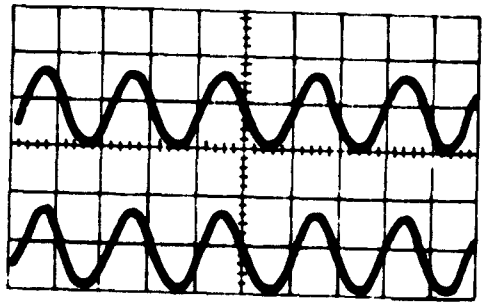
(a) @ 12.5 ips .25 %

(b) @ 25 ips .15 %

REMARKS:

4.3.1.2.1.3(d) (Continued)

Frequency response Pictures AN/GLH-4 SER 102 Head Ser. 249

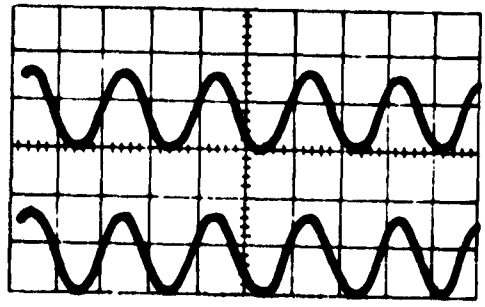


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 1 50 KCS

Scale: Vertical: 1.0v/DIV
Horizontal: 10 μ sec/DIV

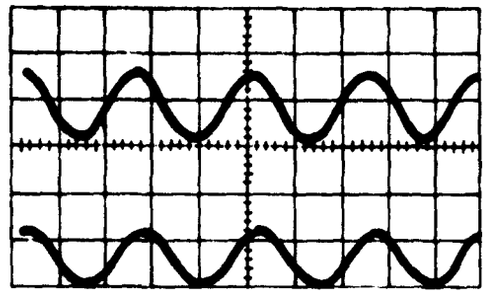


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 2 1 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.5 μ sec/DIV

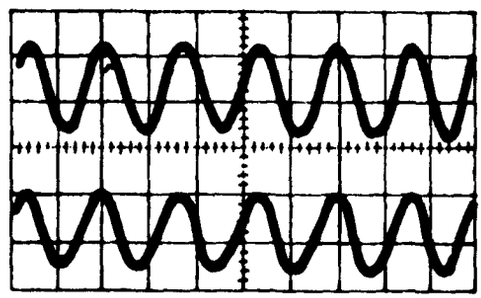


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 3 2 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.2 μ sec/DIV

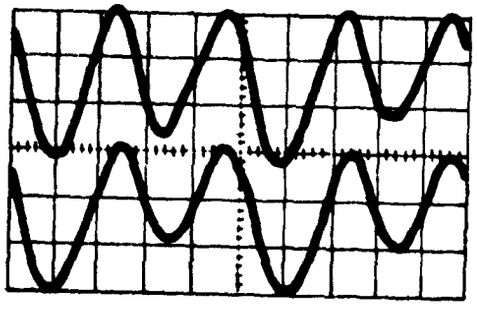


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 4 3 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.2 μ sec/DIV



CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

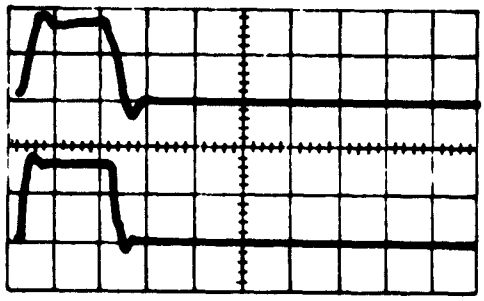
Fig. 5 4 MCS

Scale: Vertical: 0.2 v/DIV
Horizontal: 0.1 u sec/DIV

4.3.1.2.1.4 (g) (Continued)

Pulse Response Pictures AN/GLH-4 Serial 102 Head Serial 249

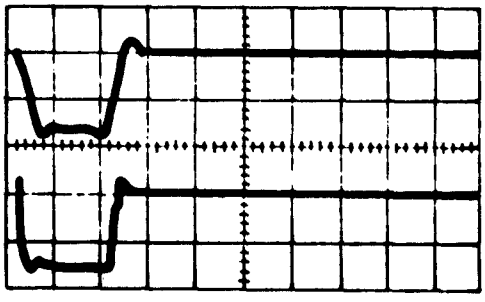
Scale (all pictures): Horizontal: 0.5 u sec/DIV
Vertical 0.5 V/DIV



CHANNEL 1
Reproduced

INPUT PULSE

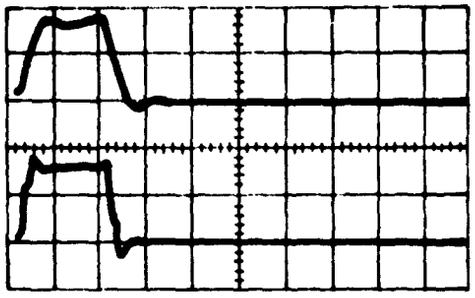
Fig. 1 1 μsec positive going pulse



CHANNEL 1
Reproduced

INPUT PULSE

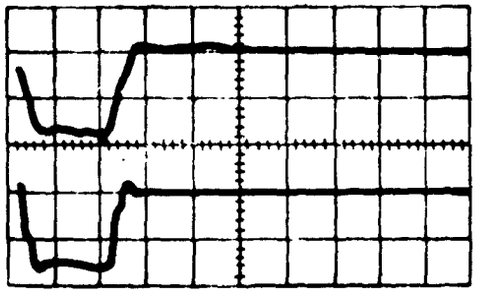
Fig. 2 1 μsec negative going pulse



CHANNEL 2
Reproduced

INPUT PULSE

Fig. 3 1 μsec positive going pulse



CHANNEL 2
Reproduced

INPUT PULSE

Fig. 4 1 μsec negative going pulse

AMPEX INSTRUMENTATION PRODUCTS COMPANY

REDWOOD CITY, CALIFORNIA

Test Date

Preliminary Acceptance Test

Model AN/GLH-4 (XW-1) Recorder-Reproducer Set, Signal Data

Date 7-25-61

CPD or SO 527591

Equipment Serial 103

Transport Serial 115

Wideband Head Serial 204

Auxiliary Head Serial 103

Tape Type 1 Mil Mylar

Test equipment Calibration up-to-date: Yes ✓ No ____

Checked by: Don Anderson Dept. 749

Norm Smith 431

R. L. Smith for Roy Eng 431

App'd by [illegible] AFSCN Date 27 Jul 61

Surveillance

Wideband head hours 34

Purpose: This data sheet shall be used to record the performance of the required tests and measurements. All tabulated data shall show the exact measurement value regardless of the end result. Where no data is applicable answer yes, no or make suitable remarks.

REMARKS

Reference: The following paragraph numbers correspond to the paragraph numbers in ST-48000 C, Preliminary Acceptance Test Specification, AN/GLH-4 (XW-1)

4.1 Mechanical Inspection Tests OK

4.1.1 Visual OK

4.1.1.1 Quality of workmanship OK

4.1.1.2 Identification Marking per MIL-STD-130 Yes

4.1.1.3 Color per FED-STD-595 #36176 Yes

4.2 Electrical Inspection Tests OK

4.2.1 Required Electrical Tests OK

4.2.1.1 Power Distribution

(1) Power

(1.1) Frequency Changer

Output A: 30 VDC

Ripple 50 MVRMS

Output B:

Line to ground

Phase A 115 VRMS

B 115 VRMS

C 115 VRMS

(1.2) Power Supplies

Output C: +27.20 VDC

Output D: 23.89 VDC

Ripple 12 MV

Output F: 23.89 VDC

Ripple 12 MV

Output E: +23.67 VDC

Output G: 23.79 VDC

Ripple 10 MV

REMARKS:

4.2.1.2 Control and Indication functions

4.2.1.2.1.1 Control functions and Interlock. OK

4.2.1.2.1.2 Tape Pack Sensor. OK

4.2.1.2.2 Control, Remote Station

4.2.1.2.2.1 Control functions and mode interlock OK

4.2.1.2.2.2 T ape Pack Sensor OK

4.2.1.2.2.3 Control Status Interlock OK

4.2.1.2.3 Control Indication OK

4.2.1.2.4 Remote Indication of Anticipation of End of Tape

- 12.5 ips 47 sec
- 25 ips 40 sec

4.2.1.2 5 R-mote Indication of End of Tape OK

4.2.1.2.6 Record Confidence Monitor OK

4.2.2 Optional Electrical Inspection Tests

4.2.2.1 Inherent Soundness of Circuitry

(1) Wide Band Record

(1.1) Modulator

(a) Dash 1 H.F. Osc. frequency 87 Mc
(b) Dash 2 L.F. Osc. frequency 100 Mc
(c) Carrier frequency
Channel 1 6 Mc
Channel 2 6 Mc

(1.2) Carrier level
(a) Channel 1 head 1 & 3 65 Vpp
(b) Channel 1 head 2 & 4 65 Vpp
(c) Channel 2 70 Vpp

REMARKS

(1.3) Timing Pulse Position

(1.3.1) Pulse Slope

(a) Rise Time 0.15 μ SEC

(b) Fall Time 0.25 μ SEC

(c) Width (50% Amplitude) 2.8 μ SEC

(1.3.2) Pulse Position

(a) Head 2; beginning of carrier to timing pulse 66 μ sec.

(b) Head 1; end of carrier to timing pulse 80 μ sec.

(1.4) Control Track Record:

(a) Wave form conforms to specification requirements Yes

(b) Amplitude 0.7 V p-p

(2) WideBand Reproduce

(2.1) Female Guide Servo OK

(2.2) AM Pulse Detector timing pulses OK

(2.3) Switcher AFC Yes

(2.4) Switcher Gated Amplifier 1.0 Vpp

(2.5) Tracking Phase Control Yes

(2.6) Control Track Reproduce

(a) TP-1 3.0 Vpp

(b) TP-2 3.0 Vpp

(2.7) Head Drum Servo

(a) Wave from synnetry 2.0 %

(b) Jetter 10 μsec p-p

(2.8) Capstan Servo

(a) Wave form conforms to specification requirments Yes

(b) Wave Movement None

REMARKS:

(3) Auxiliaries Record

(3.1) Record current 0.7 ma RMS

(3.2) Bias

(a) Current 12 ma RMS
(b) Frequency 104.3 Kc
(c) Distortion _____ % CH-1 -28
CH-2 -27

(3.3) Erase

(a) Current 110 ma

4.2.2.2 Radio Frequency Interference _____

4.3 Performance Tests

4.3.1 Required Performance Tests

4.3.1.1 Mechanical Performance Tests

4.3.1.1.1 Tape Speed

4.3.1.1.1.1 Record and Reproduce

(a) @ 12.5 ips 10.03 sec
_____ %

(b) @ 25. ips 998 sec
_____ %

4.3.1.1.12 Fast Forward and Rewind

(a) Fast forward 4.2 min
(b) Rewind 4.1 min

4.3.1.1.2 Start Time

4.3.1.1.2.1 Start Time Record Mode

(a) Head drum trace 3.5 sec

(b) Capstan trace 3.0 sec

REMARKS:

4.3.1.1.2.2 Start Time Reproduce Mode 5.0 sec

4.3.1.1.3 Stop Time

4.3.1.1.3.1 Stop Time Record and Reproduce

(a) Record

1. @ 12.5 ips .5 sec

2. @ 25 ips .5 sec

(b) R eproduce

1. @ 12.5 ips .5 sec

2. @ 25 ips .5 sec

4.3.1.1.3.2 Stop Time Fast Forward and Rewind

(a) Fast Forward 1.0 sec

(b) Rewind 1.0 sec.

4.3.1.1.4 Tape packing slip None in.

4.3.1.1.5 Automatic Stop Yes

4.3.1.2 Electrical Performance Tests

4.3.1.2.1 Wide Band Signal Channels

4.3.1.2.1.1 Output Level

(a) Reference level	-3	dbm
(b) J-175	-3	dbm
(c) J-179	-3	dbm
(d) J-257	-3	dbm
(e) J-259	-3	DBM

4.3.1.2.1.2 Signal-to-noise Ratio

(a) Reference level channel 1	-3	dbm
(b) Reference level channel 2	-3	dbm
(c) Noise level channel 1	-26	dbm
(d) Noise level channel 2	-29 1/2	dbm
(e) S/N Ratio channel 1	-32	db
(f) S/N Ratio Channel 2	-35.5	db

REMARKS:

4.3.1.2.1.3 Frequency Response

(a) Channel 1 Reference level -3 db

(b) Channel 2 Reference level -3 db

(c) Response level

Frequency	Channel 1	Channel 2
10c	-8 db	-8 db
50c	-2 3/4 db	-3 db
100c	-2 1/2 db	-3 db
500c	-2 1/2 db	-3 db
5 kc	-2 1/2 db	-3 db
10 kc	-2 1/2 db	-3 db
50 kc	-3 db	-3 db
100 kc	-3 db	-3 1/2 db
1 mc	-3 db	-3 db
2 mc	-2 db	-3 1/2 db
2.5mc	-3 1/2 db	-4 1/2 db
3 mc	-5 1/2 db	-7 db
4 mc	-9 1/2 db	-11 1/2 db

(d) Frequency Response Scope Pictures

1. 50 k.c. Attached
2. 1 mc "
3. 2 mc "
4. 3 mc "
5. 4 mc "

4.3.1.2.1.4 Pulse Response

		Channel 1	Channel 2
(a)	Rise Time	.15 usec	.16 usec
(b)	Delay Time	.12 usec	.12 usec
(c)	Overshoot	8 %	6 %
(d)	Droop	1 %	1 %
(e)	Output voltage	1.6 up	1.6 up
(f)	Undershoot	5 %	5 %

(g) Pulse Response Pictures

1. Channel 1 1 u sec pulse 0 to .8 volts peak positive going
2. Channel 2 " " "
3. Channel 1 " " negative going attached
4. Channel " " "

REMARKS:

There appeared to be an overshoot on the trailing edge of the 100 KC of 10-15%, also an undershoot. This could be due to reflection in the loading.

4.3.1.2.1.5 Fidelity of Reproduced Signal

	Channel 1	Channel 2
2nd Harmonic Amplitude	11.3%	8%
3 rd " "	2%	.5%
Distortion	11.3 %	8.0 %

4.3.1.2.1.6 Switching Transient

4.3.1.2.1.6.1 Amplitude 1.0 v p.p *

4.3.1.2.1.6.2 Clamp Period 0.4 u sec

4.3.1.2.1.7 Crosstalk

(a) Channel 1 signal level -3 db m
(b) Channel 2 crosstalk level -25.5 dbm
(c) Channel 2 crosstalk -31.5 db
(d) Channel 2 signal level -3 dbm
(e) Channel 1 crosstalk level -26 dbm
(f) Channel 1 crosstalk -32 db

4.3.1.2.1.8 Dynamic Linearity

(a) Channel 1

Input level		Output level
1.2 v p-p		1.19 Vpp
1.6 v p-p	Ref (adj)	1.6 vpp
0.8 v p-p		0.79 vpp
0.5 v p-p		0.49 vpp

(b) Channel 2

Input level		Output level
1. 2 v p-p		1.19 vpp
1.6 vpp	Ref (adj)	1.6 vpp
0.8 vpp		0.79 vpp
0.5 vpp		0.49 vpp

4.3.1.2.1.9 Timing Accuracy

(a) @ 12.5 ips ±3 µ sec
(b) @ 25 ips ±3 µ sec

4.3.1.2.2 Auxiliary Signal Channel

4.3.1.2.2.1 Output level

(a) Channel 1 1.0 vRMS
(b) Channel 2 1.0 vRMS

REMARKS:

4.3.1.2.2.2 Frequency Response

(a) Channel 1 Reference level +2 db

(b) Channel 2 Reference level +2 db

(c) Response level

Frequency	25 IPS Channel 1	25 IPS Channel 2	12.5 IPS Channel 1	12.5 IPS Channel 2
300 c	- 1/2 dbm	-1 dbm	0 dbm	- 1/2 dbm
500 c	+2 dbm	+2 dbm	+2 dbm	+2 dbm
1 kc	+2 dbm	+2 dbm	+3.5 dbm	+4.5 dbm
10 kc	+2 dbm	+3.5 dbm	+2.5 dbm	+3.2 dbm
15 kc	+1 1/2 dbm	+3.5 dbm	0 dbm	+1/2 dbm
3 kc	+1 1/2 dbm	+3.5 dbm	+4 dbm	+4 3/4 dbm

4.3.1.2.2.3 Signal-to-Noise Ratio

	25 IPS	12.5 IPS
(a) Reference level Channel 1	+2 dbm	+2 dbm
(b) Reference level channel 2	+2 dbm	+2 dbm
(c) Noise level channel 1	-32.5 dbm	-32 dbm
(d) " " " 2	-32.0 dbm	-34 dbm
(e) S/N Ratio " 1	-34.5 db	-34 db
(f) " " 2	-34.0 db	-36 db

4.3.1.2.2.4 Crosstalk

	25 IPS	12.5 IPS
(a) Channel 1 signal level	+2 dbm	+2 dbm
(b) " 2 cross talk level	-30 dbm	-34.0 dbm
(c) " 2 cross talk	-32 db	-36 db
(d) " 2 signal level	+2 dbm	+2 dbm
(e) " 1 cross talk level	-30 dbm	-30.5 dbm
(f) " 1 cross talk	-32 db	-32.5 db

4.3.1.2.2.5 Distortion at 25 IPS

	Channel 1	Channel 2
2nd Harmonic Distortion Amplitude	2.2%	3.0%
3rd " " "	0.6%	0.5%
Distortion	2.3 %	3 %

4.3.1.2.2.6 Flutter

(a) ● 12.5 ips	0.20 %
(b) ● 25 ips	0.22 %

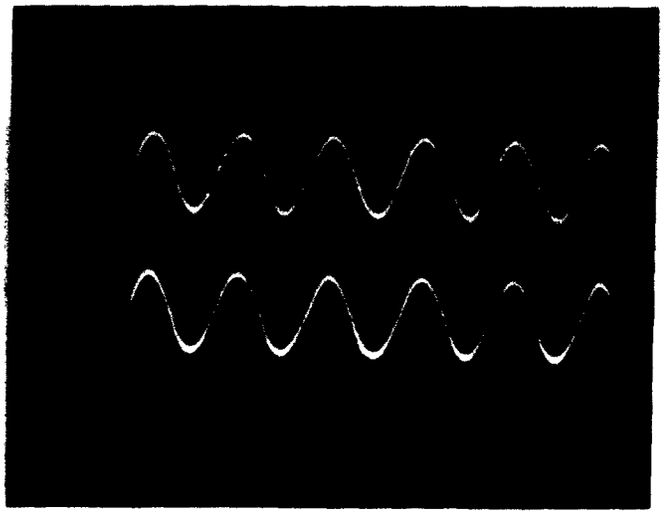
DISTORTION 12.5 IPS

	CH 1	CH 2
2nd	3.6%	4.2%
3rd	2.5%	2.0%
Total	4.4%	4.65%

REMARKS:

4.3.1.2.1.3(d) (Continued)

Frequency response Pictures AN/GLH-4 SER 103 Head Ser. 204

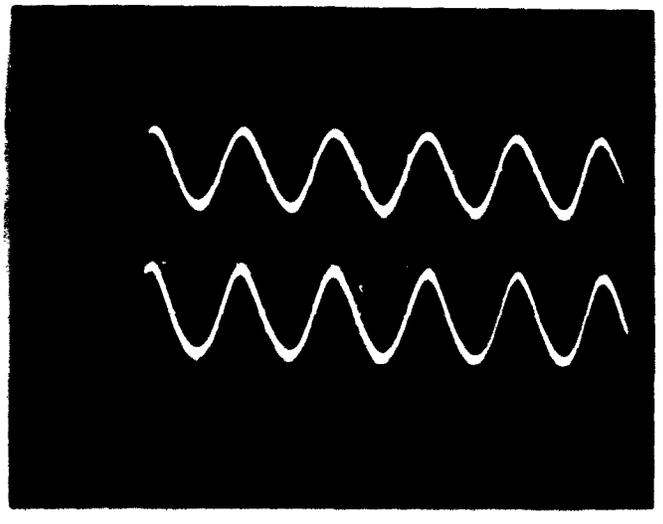


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. I 5C KCS

Scale: Vertical: 1.0v/DIV
Horizontal: 10 μ sec/DIV

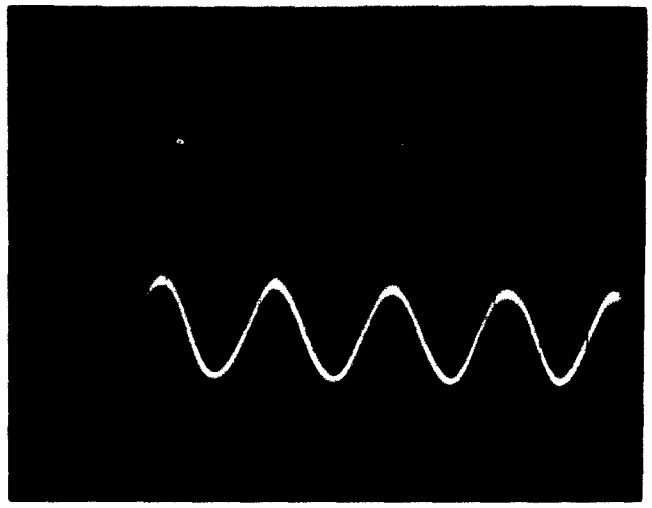


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 2 1 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.5 μ sec/DIV

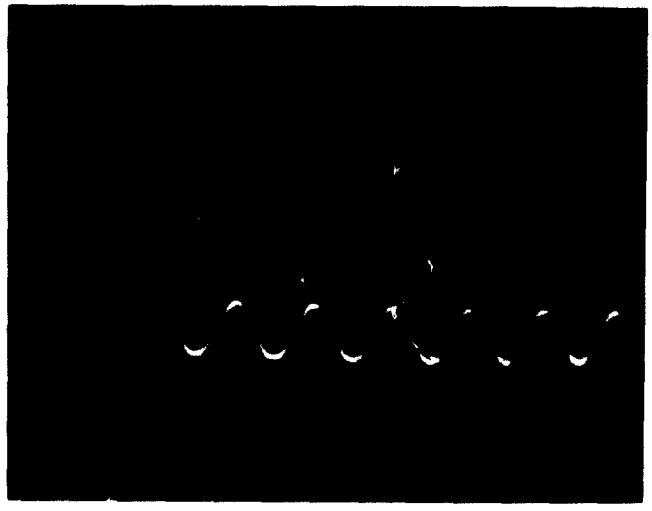


CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 3 2 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.2 μ sec/DIV



CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 4 3 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.1 μ sec/DIV

CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 5 4 MCS

Scale: Vertical: 0.5 v/DIV
Horizontal: 0.1 u sec/DIV

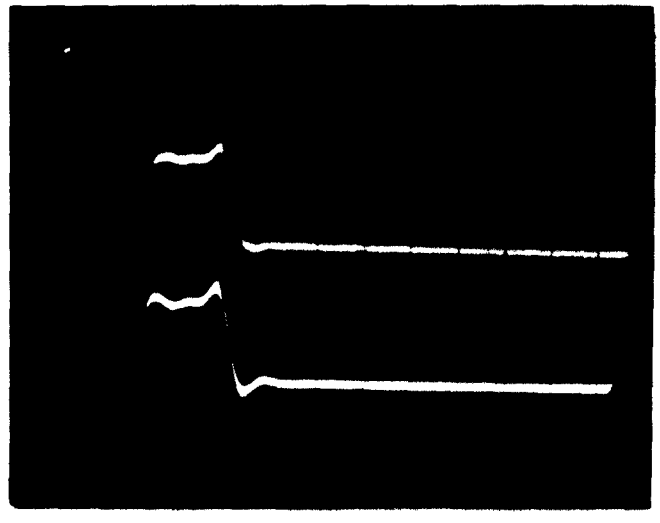
4.3.1.2.1.4(g) (Continued)

Pulse Response Pictures AN/GLH-4 SER 103 Head Ser. 204
Scale (All Pictures) Vertical: 0.5v/DIV
Horizontal: 0.5 u sec/DIV

INPUT POSITIVE GOING PULSE

INPUT NEGATIVE GOING PULSE

Fig. I 1 u-sec INPUT PULSE CHANNEL 1 and 2



CHANNEL 1 REPRODUCE

CHANNEL 2 REPRODUCE

Fig 2 1 u sec POSITIVE GOING PULSE

Fig. 3 1 u sec NEGATIVE GOING PULSE

AMPEX INSTRUMENTATION PRODUCTS COMPANY

REDWOOD CITY, CALIFORNIA

Test Data

Preliminary Acceptance Test

Model AN/GLH-4 (XW-1) Recorder-
Reproducer Set, Signal Data

Date 10-24-61

CPD or SO 527591

Equipment Serial 104

Transport Serial ______

Wideband Head Serial 210 (GLH-4 P.N. 49785-10 SER. " 101)

Auxiliary Head Serial 104

Tape Type 1 MIL MYLAR

Test equipment Cablebration up-to-date: Yes ✓ No ____

Checked By: Don Anderson Dept 749

Approved for [illegible] 749

R. Jackson 431

App'd By: [illegible] AFQ Date 27 Oct 61

Surveillance

Wideband Head hours 97

Purpose: This data sheet shall be used to record the performance of the required tests and measurements. All tabulated data shall show the exact measurement value regardless of the end result. Where no data is applicable answer yes, no or make suitable remarks.

REMARKS

Reference: The following paragraph numbers correspond to the paragraph numbers in ST-48000 C, Preliminary Acceptance Test Specification, AN/GLH-4 (XW-1)

4.1 Mechanical Inspection Tests

4.1.1 Visual

4.1.1.1 Quality of workmanship OK

4.1.1.2 Identification Marking per MIL-STD-130 OK

4.1.1.3 Color per FED-STD-595 #36176 OK

4.2 Electrical Inspection Tests

4.2.1 Required Electrical Tests

4.2.1.1 Power Distribution

(1) Power

(1.1) Frequency Changer

Output A: 27.5 VDC

Ripple 50 MVRMS

Output B:

Line to ground

Phase A 115 VRMS

B 115 VRMS

C 115 VRMS

(1.2) Power Supplies

Output C: 26.5 VDC

Output D: 23.85 VDC

Ripple 10 MV RMS

Output F: 23.85 VDC

Ripple 10 MV RMS

Output E: 23.5 VDC

Output G: 23.99 VDC

Ripple 10 MV RMS

REMARKS:

4.2.1.2 Control and Indication functions

4.2.1.2.1.1 Control functions and Interlock. OK

4.2.1.2.1.2 Tape Pack Sensor. OK

4.2.1.2.2 Control, Remote Station

4.2.1.2.2.1 Control functions and mode interlock OK

4.2.1.2.2.2 T ape Pack Sensor OK

4.2.1.2.2.3 Control Status Interlock OK

4.2.1.2.3 Control Indication OK

4.2.1.2.4 Remote Indication of Anticipation of End of Tape

- @ 12.5 ips 48 sec
- @ 25 ips 52 sec

4.2.1.2 5 Remote Indication of End of Tape

4.2.1.2.6 Record Confidence Monitor OK

4.2.2 Optional Electrical Inspection Tests

4.2.2.1 Inherent Soundness of Circuitry

(1) Wide Band Record

(1.1) Modulator

(a) Dash 1 H.F. Osc. frequency 87 Mc
(b) Dash 2 L.F. Osc. frequency 100 Mc
(c) Carrier frequency
Channel 1 6 Mc
Channel 2 6 Mc

(1.2) Carrier level
(a) Channel 1 head 1 & 3 65 Vpp
(b) Channel 1 head 2 & 4 65 Vpp
(c) Channel 2 65 Vpp

REMARKS

(1.3) Timing Pulse Position

(1.3.1) Pulse Slope

(a) Rise Time .18 μ SEC

(b) Fall Time .2 μ SEC

(c) Width (50% Amplitude) 1.9 μ SEC

(1.3.2) Pulse Position

(a) Head 2; beginning of carrier to timing pulse 80 μ sec.

(b) Head 1; end of carrier to timing pulse 80 μ sec.

(1.4) Control Track Record:

(a) Wave form conforms to specification requirements YES

(b) Amplitude .70 V p-p

(2) WideBand Reproduce

(2.1) Female Guide Servo OK

(2.2) AM Pulse Detector timing pulses YES

(2.3) Switcher AFC YES

(2.4) Switcher Gated Amplifier 1.0 Vpp

(2.5) Tracking Phase Control YES

(2.6) Control Track Reproduce

(a) TP-1 2.5 Vpp

(b) TP-2 30 Vpp

(2.7) Head Drum Servo

(a) Wave from synnetry 5.0 %

(b) Jetter 15 μsec p-p

(2.8) Capstan Servo

(a) Wave form conforms to specification requirments YES

(b) Wave Movement NONE

REMARKS:

(3) Auxiliaries Record

(3.1) Record current .7 ma RMS

(3.2) Bias

(a) Current 12 ma RMS
(b) Frequency 100 Kc
(c) Distortion 2.8 % CH I 2.6%
CH II 2.8%

(3.3) Erase

(a) Current 110 ma

4.2.2.2 Radio Frequency Interference

4.3 Performance Tests

4.3.1 Required Performance Tests

4.3.1.1 Mechanical Performance Tests

4.3.1.1.1 Tape Speed

4.3.1.1.1.1 Record and Reproduce

(a) ● 12.5 ips 9.98 sec
2.0 %

(b) ● 25. ips 9.98 sec
2.0 %

4.3.1.1.12 Fast Forward and Rewind

(a) Fast forward 4.1 min
(b) Rewind 4.1 min

4.3.1.1.2 Start Time

4.3.1.1.2.1 Start Time Record Mode

(a) Head drum trace 3.8 sec

(b) Capstan trace 3.8 sec

REMARKS:

4.3.1.1.2.2 Start Time Reproduce Mode 4.5 sec

4.3.1.1.3 Stop Time

4.3.1.1.3.1 Stop Time Record and Reproduce

(a) Record
1. @ 12.5 ips 0.5 sec
2. @ 25 ips 0.5 sec

(b) R eproduce

1. @ 12.5 ips 0.5 sec
2. @ 25 ips 0.5 sec

4.3.1.1.3.2 Stop Time Fast Forward and Rewind

(a) Fast Forward 0.6 sec
(b) Rewind 0.6 sec.

4.3.1.1.4 Tape packing slip 0 in.

4.3.1.1.5 Automatic Stop OK

4.3.1.2 Electrical Performance Tests

4.3.1.2.1 Wide Band Signal Channels

4.3.1.2.1.1 Output Level

(a) Reference level	-3	db
(b) J-175	-3	db
(c) J-179	-3	db
(d) J-257		db
(e) J-259		DB

4.3.1.2.1.2 Signal-to-noise Ratio

	25 ips		12.5 ips
(a) Reference level channel 1	-3	db	-3
(b) Reference level channel 2	-3	db	—
(c) Noise level channel 1	-30	db	-30
(d) Noise level channel 2	-31	db	—
(e) S/N Ratio channel 1	-38	db	-38
(f) S/N Ratio Channel 2	-39	db	—

REMARKS:

4.3.1.2.1.3 Frequency Response

(a) Channel 1 Reference level -3 db

(b) Channel 2 Reference level -3 db

(c) Response level

Frequency	25 ips Channel 1	25 ips Channel 2	12.5 ips
10c	-6 1/4 db	-6 1/2 db	-6 1/4
50c	-2 1/2 db	-2 1/2 db	-2 1/2
100c	-3 db	-2 1/2 db	-2 1/2
500c	-3 db	-3 db	-3
5 kc	-3 db	-3 db	-3
10 kc	-3 db	-3 db	-3
50 kc	-3 db	-3 db	-3
100 kc	-3 1/2 db	-3 db	-3 1/2
1 mc	-4 db	-3 1/2 db	-4
2 mc	-4 1/2 db	-3 1/2 db	-4
2.5mc	-5 1/2 db	-5 db	-5
3 mc	-7 db	-7 1/2 db	-6 1/2
4 mc	-10 1/2 db	-12 1/2 db	-10

(d) Frequency Response Scope Pictures

1. 50 k.c. YES
2. 1 mc YES
3. 2 mc YES
4. 3 mc YES
5. 4 mc YES

4.3.1.2.1.4 Pulse Response

	Channel 1	Channel 2
(a) Rise Time	0.15 usec	0.15 usec
(b) Delay Time	0.13 usec	0.13 usec
(c) Overshoot	10 %	10 %
(d) Droop	2 %	2 %
(e) Output voltage	1.6 up	1.6 up
(f) Undershoot	6 %	5 %

(g) Pulse Response Pictures

1. Channel 1 1 u sec pulse 0 to .8 volts peak positive going
2. Channel 2 " " "
3. Channel 1 " " " negative going
4. Channel " " "

REMARKS:

4.3.1.2.1.5 Fidelity of Reproduced Signal

		25 ips Channel 1	25 ips Channel 2	12.5 ips
	E_1	0.5	0.68	0.5
2nd Harmonic Amplitude	E_2	0.05	0.015	0.05
3 rd " "	E_3	0.003	0.0038	0.003
Distortion		10 %	25 %	10.0%

4.3.1.2.1.6 Switching Transient

4.3.1.2.1.6.1 Amplitude _____ v p.p

4.3.1.2.1.6.2 Clamp Period _____ u sec

4.3.1.2.1.7 Crosstalk

(a) Channel 1 signal level -3 db
(b) Channel 2 crosstalk level -30 db
(c) Channel 2 crosstalk -35 db
(d) Channel 2 signal level -3 db
(e) Channel 1 crosstalk level -28 db
(f) Channel 1 crosstalk -33 db

4.3.1.2.1.8 Dynamic Linearity

(a) Channel 1

Input level		Output level
2 v p-p		2 Vpp
1.6 v p-p	Ref (adj)	1.6 vpp
1.0 v p-p		1.0 vpp
0.5 v p-p		0.5 vpp

(b) Channel 2

Input level		Output level
2 v p-p		2 vpp
1.6 vpp	Ref (adj)	1.6 vpp
1.0 vpp		1.0 vpp
0.5 vpp		0.5 vpp

4.3.1.2.1.9 Timing Accuracy

(a) ● 12.5 ips ± 1 μ sec
(b) ● 25 ips ± 2 μ sec

4.3.1.2.2 Auxiliary Signal Channel

4.3.1.2.2.1 Output level

(a) Channel 1 1 vRMS
(b) Channel 2 1 vRMS

REMARKS:

4.3.1.2.2.2 Frequency Response

(a) Channel 1 Reference level +2 db

(b) Channel 2 Reference level +2 db

(c) Response level

Frequency	Channel 1	Channel 2
300 c	-1 db	-1 db
500 c	-1 db	-1 db
1 kc	+2 db	+2 db
10 kc	+4 db	+3 1/2 db
15 kc	+3 db	+2 db

4.3.1.2.2.3 Signal-to-Noise Ratio

(a) Reference level Channel 1 +2 db

(b) Reference level channel 2 +2 db

(c) Noise level channel 1 -33 db

(d) " " " 2 -34 db

(e) S/N Ratio " 1 -35 db

(f) " " 2 -36 db

4.3.1.2.2.4 Crosstalk

(a) Channel 1 signal level +2 db

(b) " 2 cross talk level -33 db

(c) " 2 cross talk -35 db

(d) " 2 signal level +2 db

(e) " 1 cross talk level -33 db

(f) " 1 cross talk -35 db

4.3.1.2.2.5 Distortion

	Channel 1	Channel 2
2nd Harmonic Distortion Amplitude	3.0	3.0
3rd " " "	1.0	1.2
Distortion	%	%

4.3.1.2.2.6 Flutter

(a) ● 12.5 ips .25 %

(b) ● 25 ips .20 %

REMARKS:

4.3.1.2.1.3(d) (Continued)

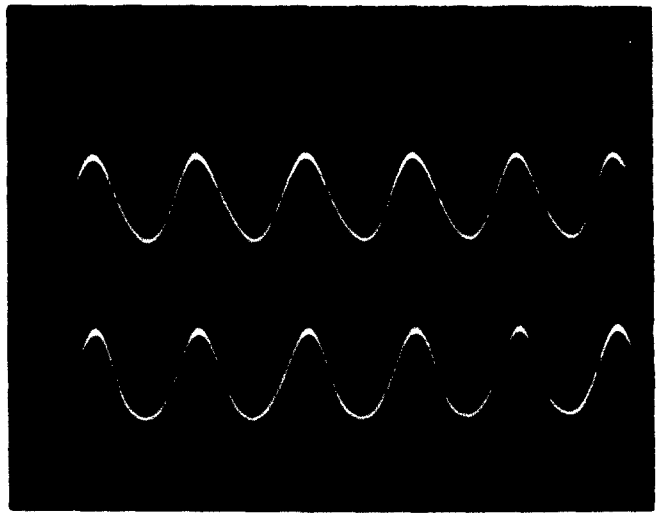
Frequency response Pictures AN/GLH-4 SER 104 Head Ser. 101

CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. I 50 KCS

Scale: Vertical: 1.0v/DIV
Horizontal: 10 μ sec/DIV



CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 2 1 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.5 μ sec/DIV

CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 3 2 MCS

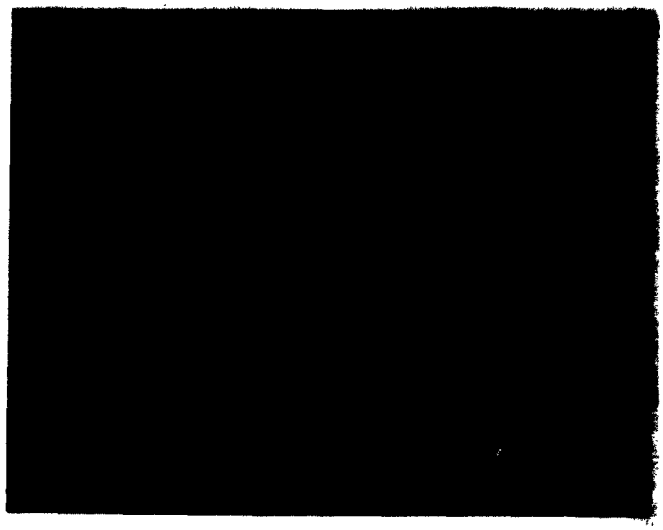
Scale: Vertical: 1.0 v/DIV
Horizontal: 0.2 μ sec/DIV

CHANNEL 1
Reproduced

CHANNEL 2
Reproduced

Fig. 4 3 MCS

Scale: Vertical: 1.0 v/DIV
Horizontal: 0.2 μ sec/DIV



CHANNEL 1
Reproduced

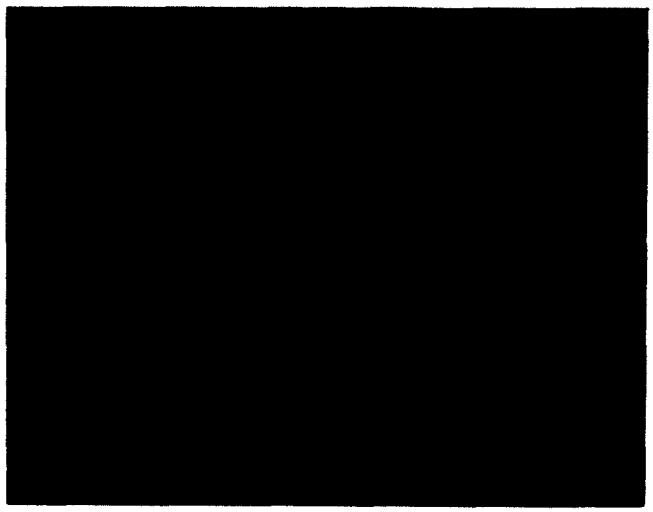
CHANNEL 2
Reproduced

Fig. 5 4 MCS

Scale: Vertical: 0.5 v/DIV
Horizontal: 0.1 u sec/DIV

4.3.1.2.1.4(g) (Continued)

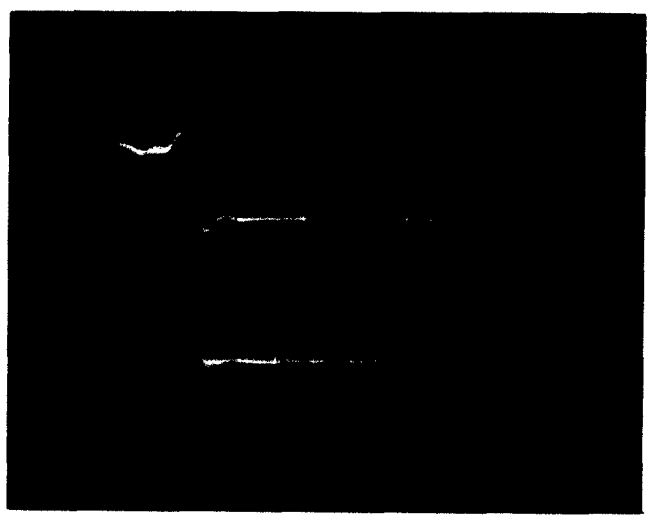
Pulse Response Pictures AN/GLH-4 SER 104 Head Ser. 101
Scale (All Pictures) Vertical: 0.5v/DIV
Horizontal: 0.5 u sec/DIV



INPUT POSITIVE GOING PULSE

INPUT NEGATIVE GOING PULSE

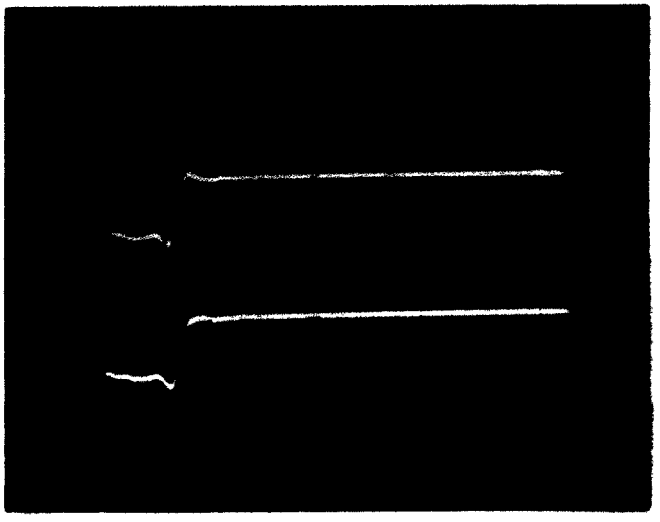
Fig. I 1 u sec INPUT PULSE CHANNEL 1 and 2



CHANNEL 1 REPRODUCE

CHANNEL 2 REPRODUCE

Fig 2 1 u sec POSITIVE GOING PULSE



CHANNEL 1
REPRODUCE

CHANNEL 2
REPRODUCE

Fig. 3 1 u sec NEGATIVE GOING PULSE

APPENDIX III

FINAL REPORT
ON
FR-700 - AN/GLH-4 RECORDER/REPRODUCER
FOR
AMPEX DATA PRODUCTS CO.
TO
MIL-I-26600(USAF)

PROJECT NO.: FLP-7226

FILTRON COMPANY, INC.
PALO ALTO, CALIFORNIA
SYSTEMS ENGINEERING DIVISION

ADMINISTRATIVE DATA

DATE: 3 April 1961

PURPOSE OF TEST: The purpose of this test was to determine conformance of the described specimen to the radio interference requirements of Specification MIL-I-26600(USAF), or to determine suppression measures, as required, to reduce the specimen generated interference to a level acceptable under this specification.

MANUFACTURER: Ampex Data Products Co., Redwood City, California

MANUFACTURER'S TYPE, OR MODEL NO.: FR-700, AN/GLH-4, Recorder-Reproducer

DRAWING, SPECIFICATION, OR EXHIBIT: Test Procedure, FLP-7226, and MIL-I-26600(USAF)

QUANTITY OF ITEMS TESTED: One (1)

SECURITY CLASSIFICATION OF ITEM: Unclassified

DATE TEST COMPLETED: 30 March 1961

TEST CONDUCTED BY: Filtron Company, Inc., Palo Alto, California

TEST CONDUCTED FOR: Ampex Data Products Co., Redwood City, California

DISPOSITION OF SPECIMEN: Returned to Ampex Data Products Co.

ABSTRACT: Radiated and conducted interference and susceptibility measurements were performed on the FR-700, Type AN/GLH-4. The results of these tests indicate that the described specimen does not meet the radio interference requirements of Specification MIL-I-26600(USAF).

FACTUAL DATA

1.0 DESCRIPTION:

1.1 The test specimen was a Model FR-700, Type AN/GLH-4, Serial No. #4, manufactured by Ampex Data Products Co. The test sample was a wide band magnetic recorder/reproducer with Filtron filter, type FA 6883A installed, that has been developed for the United States Air Force by Ampex Data Products Co. This machine is capable of recording wide band signals from ten cycles to four megacycles on two tracks for one-half hour, or single track for one hour. Two auxiliary tracks are available for recording signals from 20 cps to 15 KC.

1.2 The following accessory equipment, required to provide the operating conditions under which this test was performed, was employed:

1.2.1 Hewlett-Packard Voltmeter, Model 400D, Serial No. 2476. Date of last calibration was 9 February 1961.

2.0 TEST EQUIPMENT:

2.1 Empire Devices Radio Interference Field Intensity Meter, Model NF-105, Serial No. 128, with dipole antenna DM-105 and rod antenna VA-105.

2.1.1 This instrument contains an internal calibrating device rated by the manufacturer as a secondary standard. The date of last frequency and sensitivity calibration was 17 March 1961.

2.1.2 Prior evaluation of the interference measuring instrument determined the inherent noise level of the receiver to be 40 db, or less throughout the entire applicable frequency range.

2.2 Filtron FSR 703N Line Impedance Stabilization Networks, 2 each, per MIL-I-26600(USAF).

2.3 Three General Radio Signal Generators were used to provide RF susceptibility voltages.

1. General Radio Signal Generator, Type 805A, Serial No. 237, calibrated 16 December 1960

2. General Radio Signal Generator, Type 1021-P3B, Serial No. 1805, calibrated 1 February 1961

3. General Radio Signal Generator, Type 1021-P2, Serial No. 1709, calibrated 1 February 1961

3.0 TEST PROCEDURE:

3.1 Employing a 12 x 24 x 8 foot shielded enclosure, the test specimen, as received, was set up for radio interference test as prescribed by Specification MIL-I-26600(USAF) and Test Procedure FLP-7226 at a test site located on the premises of Filtron Company, Inc., 926 Industrial Avenue, Palo Alto, California. Appropriate line impedance stabilization networks were inserted in each 115 volt 60 cps lead.

3.2 Conducted broadband interference measurements were made on these lines over the frequency range of .15 to 25 mc to determine conformance to specification.

3.3 Conducted CW interference measurements were made on the power input circuits over the applicable frequency range of .15 to 25 mc in accordance with specification.

3.4 Radiated interference measurements were made over the frequency range of .15 to 1000 mc with the antenna of the test equipment located and oriented as prescribed by specification.

3.4.1 Specification prescribed antenna induced voltage was determined as follows:

Frequency	50 mc
Meter Reading	< 38 db
Antenna Factor	8 db
Cable Loss Factor	2 db
Actual Interference Amplitude	< 48 db

3.5 Susceptibility tests, as required, were performed in accordance with specification by injecting the prescribed RF voltages into the power input circuits. The entire test specimen was then subjected to an externally generated field of radiated RF energy.

3.5.1 Monitoring for malfunction, or degradation of performance during susceptibility testing was accomplished by continually monitoring recorder tape while subjecting sample to RF voltages, as per paragraph 3.5 of this report and monitoring the tape for undesirable signals on completion of the test.

4.1 Following incorporation of the suppression measures described in paragraph 1.1 of this report, broadband conducted interference was found to be within the limits of MIL-I-26600(USAF) throughout the applicable frequency range. The resulting interference curve most closely approaches specification limits at .15 mc, where the interference level was determined to be 92 db above one microvolt per mc and specification limit is 115 db.

4.2 Following incorporation of the suppression measures described in paragraph 1.1 of this report, CW conducted interference was within the limits of MIL-I-26600(USAF). The maximum CW interference was 16 db above one microvolt at approximately 6.5 mc, which is 17 db below the limits of MIL-I-26600(USAF).

4.3 No broadband radiated interference in excess of ambient levels was encountered over the entire frequency range.

4.4 Following incorporation of the suppression measures described in paragraph 1.1 of this report, CW radiated interference exceeded the limits of MIL-I-26600(USAF). The maximum CW interference was 37 db above one microvolt at approximately 270 mc, which is 5 db above specification limits.

4.5 Susceptibility tests indicate that the described specimen meets the requirements of Specification MIL-I-26600(USAF), since no malfunction of the test sample was detected when monitored as described in paragraph 3.5 of this report.

4.6 Since CW conducted and broadband radiated interference levels of the test sample were so far below specification limits, no curves were plotted.

5.0 COMMENTS:

5.1 Use of a probe indicated that most of the remaining interference being emitted by the test sample was coming from the recording head and the control panel. It is safe to assume that

the test sample would meet the radiated limits of MIL-I-26600(USAF), if the control panel were grounded and more adequate shielding were provided for the recording head.

6.0 CONCLUSION:

6.1 Following incorporation of the suppression measures described in paragraph 1.1 of this report and when tested as described, the Model FR-700, AN/GLH-4 does not meet the radio interference requirements of Specification MIL-I-26600(USAF).

NOTE: The results obtained in this test, as presented in this report, refer only to the test sample as submitted. Any changes in circuit, components, grounding, bonding, or lead routing, regardless how insignificant, may render this report invalid.

William Rumberger
Engineer

Peter Spencer
Zone Manager

PROJECT: FLP-7226

Report No. 1

ENGINEERING DEPARTMENT

FILTRON COMPANY, INC.

ENGINEERING TEST REPORT

FLP-7226

RADIO FREQUENCY SUPPRESSION LABORATORY

PROJECT Ampex Data Products, Co. PAGE NO. 1

FR-700, AN/GLH-4 Recorder/Reproducer DATE 28 March 1961

BROADBAND CONDUCTED MEASUREMENTS

FREQ. MC	Line B	Line C	MIL-I-26600(USAF) Spec. Limit	FREQ. MC				
.15	92	92	115					
.2	88	85	111					
.3	79	75	105					
.4	76	73	102					
.6	65	61	97					
.8	62	59	93					
1.0	55	56	90					
1.5	47	34	84					
2.0	38	44	80					
3.0	34	34	↑					
4.0	31	31	|					
5.0	< 24	< 24	|					
6.0	< 26	< 26	|					
8.0	< 25	< 25	|					
11.0	< 24	< 24	|					
14.0	< 30	< 30	|					
18.0	< 28	< 28	↓					
25.0	< 27	< 27	80					

COMMENTS < = Less than.

All readings are in db above 1 μv/mc

SE-1289 FORM FCI-14A

SIGNED	DATE	ENGINEER	DATE	DEPT. ENG'R.	DATE	CHIEF ENGR	DATE
		WAR	3/28/61				3/28/61

Report No. 1

ENGINEERING DEPARTMENT

FILTRON COMPANY, INC.

ENGINEERING TEST REPORT

RADIO FREQUENCY SUPPRESSION LABORATORY

FLP-7226

PROJECT Ampex Data Products, Co. PAGE NO. 2

FR-700, AN/GLH-4 Recorder/Reproducer DATE 28 March 1961

CW CONDUCTED MEASUREMENTS				CW RADIATED MEASUREMENTS			
FREQ. MC	Line B	Line C	MIL-I-26600(USAF) Spec. Limits	FREQ. MC	Meter Reading	Actual Interference Amplitude	MIL-I-26600(USAF) Spec.Limits
6.1	10	10	33	6.1	14	7.5	21
6.5	16	16	33	6.5	20	12.5	21
11.8	8	9	33	8.0	13	4.	20
12.1	10	11	33	99.0	11	21	25
18.0	4	4	33	174.0	15	26	29
				194.0	22	32 *	30
				202.0	13	23	30
				250.0	21	31	31
				270.0	26	37 *	32
				277.0	17	27	33
				295.0	22	32	33
				329.0	15	24	34
				355.0	18	27	34
				367.0	21	32	35
				379.0	18	30	35
				490.0	18	32	36
				550.0	18	32	36
				590.0	18	32	37
				686.0	15	27	38
				690.0	11	23	38
				725.0	10	22	39
				1000.0	10	21	40

COMMENTS * Exceeds specification limits (see attached graph)

All frequencies are approximate

All readings are in db above 1 μv

SIGNED	DATE	ENGINEER	DATE	DEPT. ENG'R.	DATE	CHIEF ENGR	DATE
		Walt	3/28/61				3/28/61

FORM FCI-14A

Report No. 1

ENGINEERING DEPARTMENT

FILTRON COMPANY, INC.

ENGINEERING TEST REPORT FLP-7226

RADIO FREQUENCY SUPPRESSION LABORATORY

PROJECT Ampex Data Products, Co. PAGE NO. 3

FR-700, AN/GLH-4 Recorder/Reproducer DATE 28 March 1961

BROADBAND RADIATED MEASUREMENTS

FREQ. MC	Meter Reading	Actual Interference Amplitude		MIL-I-26600(USAF) Spec.Limit	FREQ. MC				
.15	33	< 64		77					
.2	34	< 61		75					
.3	30	< 59		73					
.4	28	< 58		71					
.6	28	< 53		70					
.8	30	< 60		69					
1.0	31	< 53		68					
1.5	29	< 52		68					
2.0	30	< 54		68					
3.0	26	< 52		68					
4.0	26	< 53		67					
6.0	26	< 53		67					
8.0	25	< 40		67					
10.0	24	< 36		66					
12.0	26	< 39		66					
15.0	30	< 40		66					
20.0	38	< 49.5		66					
25.0	38	< 43		43					
30.0	38	< 48		50					
35.0	38	< 47		50					
50.0	38	< 47		51					
75.0	28	< 38		52					
100.0	28	< 38		53					
150.0	29	< 39		54					
200.0	23	< 44		55					
300.0	22	< 43		57					
400.0	26	< 48		58					
500.0	22	< 44		58					
600.0	20	< 46		59					
700.0	18	< 47		59					
800.0	21	< 49		59					
900.0	21	< 49		60					
1000.0	24	< 50		60					

COMMENTS No Broadband Radiated Interference levels exceeded ambient.

All readings are in db above 1 μv/mc.

SIGNED	DATE	ENGINEER	DATE	DEPT. ENG'R.	DATE	CHIEF ENGR	DATE
	WAR		3/28/61				3/28/61

FORM FCI-14A

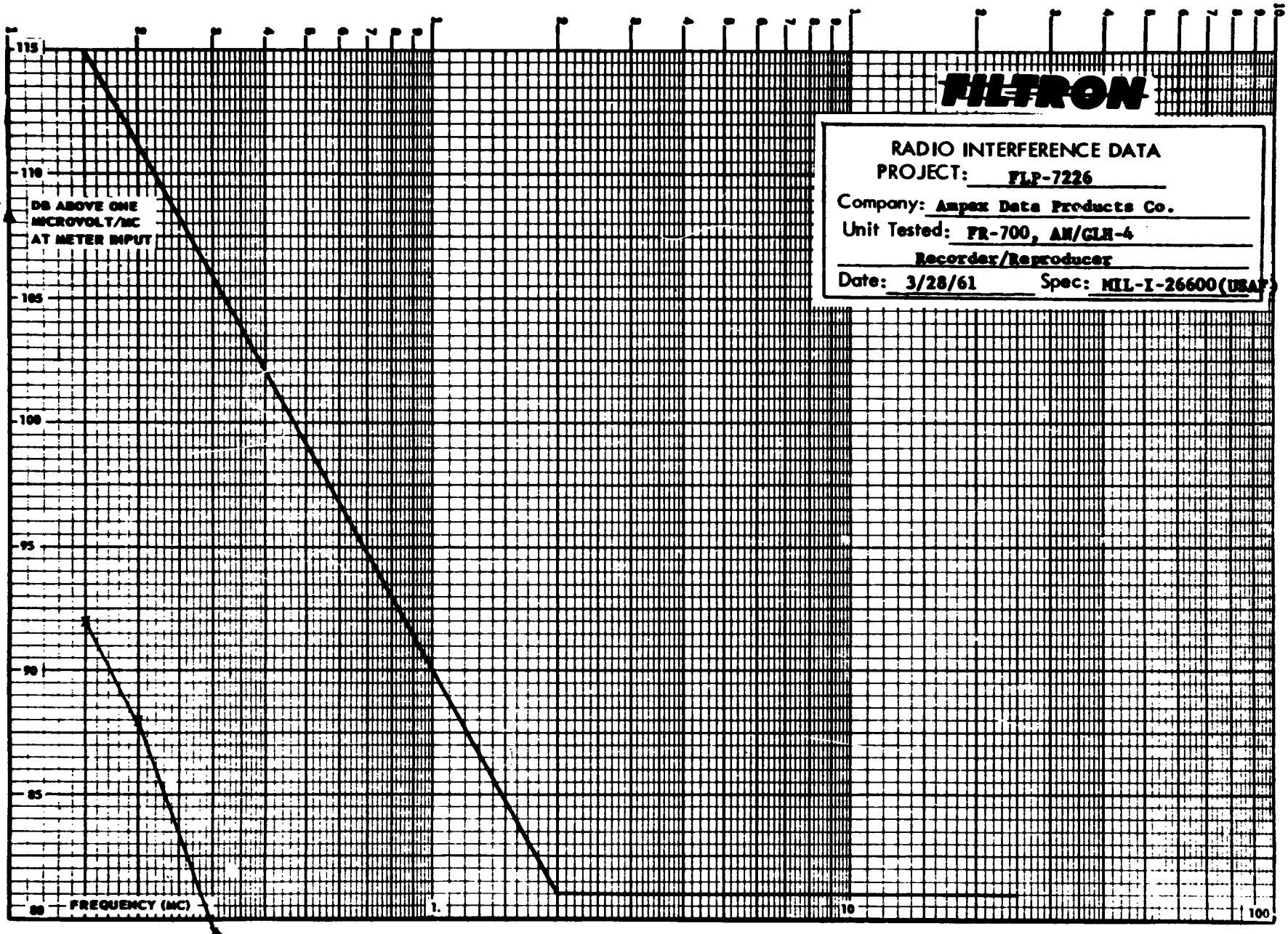


FIGURE 3. BROADBAND AND PULSED CW CONDUCTED INTERFERENCE LIMITS USING STABILIZATION NETWORK

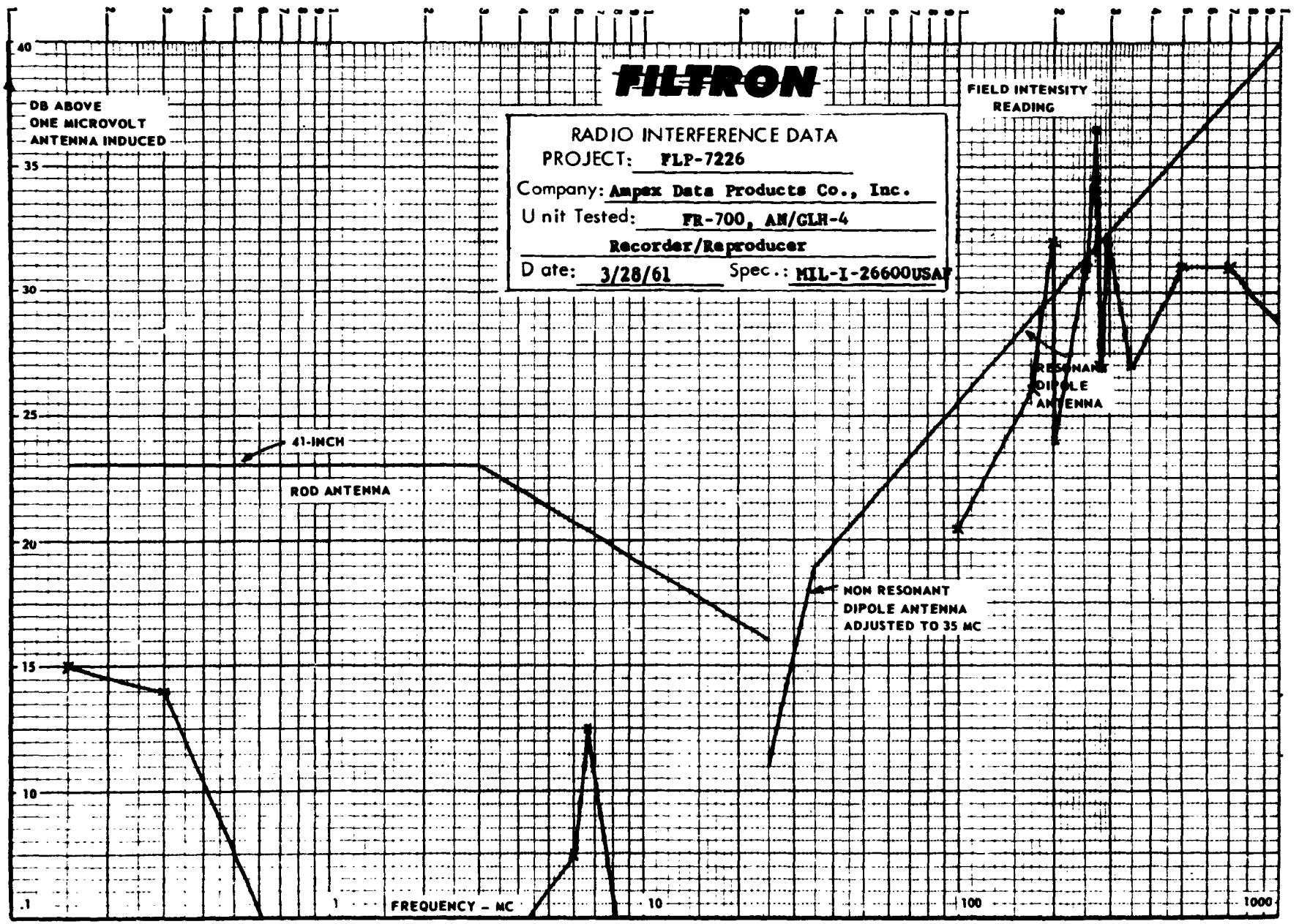


FIGURE 6. NARROW BAND (CW) RADIATED INTERFERENCE LIMITS

OCTOBER 7, 1961

FINAL TEST REPORT
ON
FR-700 AN/GLH-4(XW-1) RECORDER/REPRODUCER
SERIAL NO. 104
FOR
AMPEX DATA PRODUCTS COMPANY

PROJECT NO. FLP-7387

FILTRON COMPANY, INC.
PALO ALTO, CALIFORNIA
SYSTEMS ENGINEERING DIVISION

ADMINISTRATIVE DATA

PURPOSE OF TEST: The purpose of this test was to determine conformance of the described specimen to the radio interference requirements of Specification MIL-I-26600 (USAF), or to determine suppression measures, as required, to reduce the specimen generated interference to a level acceptable under this specification.

MANUFACTURER: Ampex Data Products Company, 860 Charter Street Redwood City, California

MANUFACTURER'S TYPE, OR MODEL NO.: FR-700, AN/GLH-4, Recorder Reproducer.

DRAWING, SPECIFICATION, OR EXHIBIT: Test Procedure, FLP-7226, and MIL-I-26600 (USAF).

QUANTITY OF ITEMS TESTED: One (1)

SECURITY CLASSIFICATION OF ITEM: Unclassified

DATE TEST COMPLETED: October 7, 1961

TEST CONDUCTED BY: Filtron Company, Inc., 926 Industrial Avenue Palo Alto, California

TEST CONDUCTED FOR: Ampex Data Products Company, 860 Charter Street Redwood City, California

DISPOSITION OF SPECIMEN: Returned to Ampex Data Products Company

ABSTRACT: Radiated and conducted interference and susceptibility measurements were performed on the FR-700, Type AN/GLH-4(XW-1) Serial No. 104. The results of these tests indicate that the described specimen meets the radio interference requirements of Specification MIL-I-26600 (USAF).

FACTUAL DATA

1.0 DESCRIPTION:

1.1 The test specimen was a Model FR-700, Type AN/GLH-4(XW-1), Serial No. 104, manufactured by Ampex Data Products Co. The unit is a Wide Band Magnetic Recorder/Reproducer, with a Filtron Line Filter, Type FA-6883 installed, that has been developed for the United States Air Force by Ampex Data Products Company. The unit was modified to include a completely shielded enclosure to house the filtered driver and modulator cards. This machine is capable of recording wide band signals from ten cycles to four megacylces, on two tracks for one-half hour, or single track for one hour. Two auxiliary tracks are available for recording signals from 20 CPS to 15 MC.

1.2 The following accessory equipment, required to provide the operating conditions under which this test was performed, was employed:

1.2.1 Oscilloscope, Tektronic Type 545-A, Serial No. 027689, last date of calibration 5/11/61.

2.0 TEST EQUIPMENT:

2.1 Empire Devices Radio Interference Field Intensity Meter, Model NF-105, Serial No. 128, with dipole antenna DM-105 and rod Antenna VA-105.

2.1.1 This instrument contains an internal calibrating device rated by the manufacturer as a secondary standard. The date of last frequency and sensitivity calibration was June 1, 1961.

2.1.2 Prior evaluation of the interference measuring instrument determined the inherent noise level of the receiver to be 36 db, or less throughout the entire applicable frequency range.

2.2 Filtron FSR-703N Line Impedance Stabilization Networks, 2 each, per MIL-I-26600 (USAF).

2.3 Three Signal Generators were used to provide RF susceptibility voltages.

Hewlett-Packard Type 606, Serial No. 139-00601.
last date of calibration March 17, 1961.

General Radio Signal Generator, Type 1021-P35, Serial No. 1805,
last date of calibration April 11, 1961.

General Radio Signal Generator, Type 1021-P2, Serial No. 1709, last date of calibration April 11, 1961.

2.4 Audio Generator HP 200 CD, Serial No. 203-31838, last date of calibration May 8, 1961.

3.0 TEST PROCEDURE:

3.1 Employing a 12 x 24 x 8 foot shielded enclosure, the test specimen, as received, was set up for radio interference test as prescribed by Specification MIL-I-26600 (USAF) at a test site located on the premises of Filtron Company, Inc., 926 Industrial Avenue, Palo Alto, California. Appropriate line impedance stabilization networks were inserted in each 115 volt 60 CPS lead.

3.2 Conducted broadband interference measurements were made on these lines over the frequency range of .15 to 25 mc to determine conformance to specification.

3.3 Conducted CW interference measurements were made on the power input circuits over the applicable frequency range of .15 to 25 mc in accordance with specification.

3.4 Radiated interference measurements were made over the frequency range of .15 to 1000 mc with the antenna of the test equipment located and oriented as prescribed by specification.

3.4.1 Specification prescribed antenna induced voltage was determined as follows:

Frequency	50 mc	
Meter Reading	< 38 db	above 1 μv/mc
Antenna Factor	8 db	
Cable Loss Factor	2 db	
Actual Interference Amplitude	< 48 db	above 1 μc/mc

3.5 Susceptibility tests, as required, were performed in accordance with specification by injecting the prescribed RF voltages into the power input circuits. The entire test specimen was then subjected to an externally generated field of radiated RF energy.

3.5.1 Monitoring for malfunction, or degradation of performance during susceptibility testing was accomplished by continually monitoring recorder tape while subjecting the sample to RF voltages, as per paragraph 3.5 of this report, and monitoring the tape for undesirable signals on completion of test.

4.0 TEST RESULTS:

4.1 Following incorporation of the suppression measures described in paragraph 1.1 of this report, broadband conducted interference was found to be within the limits of MIL-I-26600 (USAF) throughout the applicable frequency range. The resulting interference curve most closely approaches specification limits at .15 mc where the interference level was determined to be 100 db above one microvolt per mc and specification limit is 115 db.

4.2 Following incorporation of the suppression measures described in paragraph 1.1 of this report CW conducted interference was within the limits of MIL-I-26600 (USAF). The maximum CW interference was 11 db above 1 uv at approximately 6 mc, which is 22 db below specification limits.

4.3 No broadband radiated interference in excess of ambient levels was encountered over the entire frequency range.

4.4 Following incorporation of the suppression measures described in paragraph 1.1 of this report CW radiated interference was within the limits of MIL-I-26600 (USAF). the maximum CW interference was 15 db above 1μv at approximately 30 mc which is .5 db below specification limits.

4.5 Susceptibility tests indicate that the described specimen meets the requirements of Specification MIL-I-26600 (USAF) since no malfunction or degradation of the test sample's performance was detected when monitored as described in paragraph 3.5 of this report.

5.0 CONCLUSION:

6.1 Following incorporation of the suppression measures described in paragraph 1.1 of this report, when tested as described, the Model FR-700, AN/GLH-4(XW-1) meets the radio interference requirements of Specification MIL-I-26600 (USAF).

NOTE: The results obtained in this test, as presented in this report, refer only to the test sample as submitted. Any changes in circuit, components, grounding, bonding, or lead routing, regardless how insignificant, may render this report invalid.

Engineer _____
William A. Rawlings

Approved by: _____
Peter F. Spencer
Zone Manager

PROJECT: FLP-7387

Report No. FLP-7387

ENGINEERING DEPARTMENT

FILTRON COMPANY, INC.

ENGINEERING TEST REPORT

RADIO FREQUENCY SUPPRESSION LABORATORY

PROJECT AMPEX DATA PRODUCTS CO. PAGE NO. 1

DATE October 8, 1961

C.W. RADIATED INTERFERENCE

FREQ. MC	Interference Amplitude	MIL-I 26600 Spec. Limit
5.9	10	21
6.0	5	21
24.5	9	16
30.0	15	15.5
204	27	30
215	27	30.5

C.W. CONDUCTED INTERFERENCE

FREQ. MC	Inter. Amplitude Line 1	Inter. Amplitude Line II	MIL-I-26600 Spec. Limit
6	11	11	33

COMMENTS

All readings are in db above 1μv

* Denotes out of spec. reading

No other CW signals were encountered within the applicable frequency range of MIL-I-26600 (USAF).

SIGNED	DATE	ENGINEER	DATE	DEPT. ENG'R.	DATE	CHIEF ENGR	DATE
							10-20-61

SS-1329 FORM FCI-14A

Report No. FLP-7387

ENGINEERING DEPARTMENT

FILTRON COMPANY, INC.

ENGINEERING TEST REPORT

RADIO FREQUENCY SUPPRESSION LABORATORY

PROJECT AMPEX DATA PRODUCTS CO. PAGE NO. 2

DATE October 8, 1961

BROADBAND RADIATED					BROADBAND CONDUCTED				
FREQ. MC	Interference Amplitude	MIL-I-26600 Spec. Limit			FREQ. MC	Inter. Amplitude Line I	Inter. Amplitude Line II	MIL-I-26600 Spec. Limit	
.15	< 64				.15	100	94	115	
.2	< 54				.2	92	86	111	
.3	< 55				.3	82	75	105	
.4	< 58				.4	78	75	102	
.6	< 52				.6	68	60	97	
.8	< 51				.8	64	57	93	
1.0	< 47				1.0	55	56	90	
1.5	< 47				1.5	45	36	84	
2.0	< 50				2.0	36	36	81	
3.0	< 42				3.0	36	32	81	
4.0	< 43				4.0	< 26	30	81	
6.0	< 53				6.0	< 26	< 26	81	
8.0	< 40				8.0	< 25	< 25	81	
10.0	< 36				10.0	< 25	< 25	81	
15.0	< 39				15.0	< 26	< 26	81	
20.0	< 40				20.0	< 27	< 27	81	
30.0	< 49				25.0	< 27	< 27	81	
40.0	< 43								
60.0	< 48								
80.0	< 47								
100.0	< 38								
150.0	< 38								
200.0	< 38								
300.0	< 39								
400.0	< 44								
600.0	< 43								
800.0	< 46								
1000.0	< 47								

COMMENTS

< = less than

All readings are in db above 1 μv/mc

No broadband radiated interference levels exceeded ambient.

SIGNED	DATE	ENGINEER	DATE	DEPT. ENG'R.	DATE	CHIEF ENGR	DATE
							10-20-61

SE-1330 FORM PCI-1AA